HUMAN HEALTH AND ENVIRONMENTAL DAMAGES FROM MINING AND MINERAL PROCESSING WASTES

Technical Background Document Supporting the Supplemental Proposed Rule Applying Phase IV Land Disposal Restrictions to Newly Identified Mineral Processing Wastes

- Includes supplemetal attachments on (1) Mine Waste Releases and Contaminants for Selected Facilities; (2) Natural Resource Damages and (3) Releases from Phosphogypsum Storage Piles.

Office of Solid Waste
U.S. Environmental Protection Agency

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CHAPTER 1. OVERVIEW

This chapter describes (1) the purpose of the background document, (2) the process EPA used to develop the document, (3) the variety of damage cases included, and (4) conclusion. Chapter 2 presents 66 damage cases. Chapter 3 presents the report findings.

Purpose of the Background Document

The U.S. EPA Environmental Protection Agency (EPA) developed this background document to illustrate the human health and environmental damages caused by management of wastes from mining (i.e., extraction and beneficiation) and mineral processing, particularly damages caused by placement of mining and mineral processing wastes in land-based units. These damage case illustrations will provide technical support for various provisions of the supplemental proposed rule to apply Phase IV land disposal restrictions to newly identified mineral processing wastes and make other regulatory changes.

Although the damage cases in this report do not represent a statistically representative sample of all mining and mineral processing sites or the damages they have caused, the cases do provide convincing evidence that wastes from mining and mineral processing have caused significant human health and environmental damages. Both wastes that are subject to and, under the Bevill Amendment (RCRA §3001(b)(3)(A)(i-iii), exempt from regulation as hazardous wastes under Subtitle C of the Resource Conservation and Recovery Act (RCRA) are responsible for these damages. These damages occur across a broad range of mineral commodity sectors--from alumina to zirconium--and throughout all regions of the United States, in a wide variety of climatic and geological zones and in both rural and urban areas.

Process for Developing the Background Document

In preparing this background document, EPA sought to support selected aspects of the supplemental proposed rule by providing readily available examples of human health and environmental damage caused by wastes from mining and mineral processing. EPA relied primarily on the extensive data on damages from the management of mining and mineral processing wastes that EPA had previously collected and analyzed. To identify a few additional cases, EPA conducted limited new data gathering that was feasible within project constraints. In identifying existing and new damage cases to compile, EPA selected cases that demonstrate that human health and environmental damages occur across a wide range of mineral commodity sectors and throughout the United States.

EPA performed three steps to assemble this document:

(1) Compiling existing damage case summaries;

(2) Reviewing relevant inspection, enforcement, permitting, and other relevant files for mining and mineral processing facilities in selected states; and

(3) Soliciting the help of EPA Region 10 in drafting new damage cases.

Each of these steps is discussed in more detail below. While EPA also started a literature review to identify additional sites, this exercise was not completed, for two reasons. First, the results of initial searches were largely unsuccessful in identifying new damage cases. Second, other data gathering approaches appeared to be more cost-effective. Nevertheless, one damage case was based on a federal court ruling obtained through the initial literature review.

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Compiling Existing Damage Cases

EPA has conducted previous studies identifying human health and environmental damages caused by mining and mineral processing waste management activities. Four of these documents were used as the basis for preparing damage cases for this document:

(1) *Report to Congress on Special Wastes from Mineral Processing*, July 1990, U.S. Environmental Protection Agency. This report contains 16 damage cases addressing some of the 20 mineral processing wastes that EPA determined to eligible for the Bevill exemption from RCRA Subtitle C. These wastes are in 12 mineral commodity sectors and are generated by approximately 91 facilities located within 29 states.[1]

(2) *Mining Waste Release and Environmental Effects Summaries, Draft*, March 1994, U.S. Environmental Protection Agency. This series of documents identifies damage from mining and mineral processing wastes at 114 mining sites in 9 states.[2] These cases include some damages from mineral processing wastes because mining and mineral processing operations are co-located at some facilities.

(3) *Mining Sites on the National Priorities List: NPL Site Summary Report*, U.S. Environmental Protection Agency, June 21, 1991. These cases cover 48 seriously contaminated mining and mineral processing sites in 21 states that were included on the National Priorities (NPL) List by 1991.

(4) *Mining Sites on the NPL*, U.S. Environmental Protection Agency, August 1995. This document includes 32 mining and mineral processing sites that were added to the NPL between 1991 and 1995.

This background report includes all 16 damages cases from the 1990 *Report to Congress*. To supplement these *Report to Congress* cases and expand the mineral commodity sectors and geographic array of sites covered, EPA selected an additional 24 cases from *Mining Waste Release and Environmental Effects Summaries*, 17 cases from the *Mining Sites on the National Priorities List* (1991), and 3 cases from *Mining Sites on the NPL* (1995). While only 60 of the 188 damage cases in the four studies are depicted in this background document, these 60 cases cover a broad range of mineral commodity sectors and states, as described below. (An additional damage case was based on enforcement-confidential data sources.) All these case descriptions have been condensed and reformatted in a consistent manner.

Reviewing State Files

EPA contacted environmental protection agencies in six states to obtain recent information for developing new damage cases:

- Alabama
- California
- Colorado
- Massachusetts
- New Jersey
- Pennsylvania

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[1] *Report to Congress on Special Wastes from Mineral Processing*, Volume II, page 1-2.

[2] The waste release data from these reports are summarized in *Profile of the Metal Mining Industry,* September 1995, Office of Compliance Sector Notebook Project, U.S. Environmental Protection Agency, pages 37-45.

These states were selected for their diversity in mineral processing and mining sectors and their geographic range. In addition, they were selected to minimize data collection costs by allowing the EPA contractor to rely on staff already located in or traveling for other reasons to these jurisdictions.

Based on conversations with state representatives, EPA conducted limited file searches in the state capitals of Alabama, California, and Colorado. A minimum of 10 mining and/or mineral processing facilities in each state were identified as targets for the file searches. These facilities were selected to avoid duplication with facilities covered by any of the documents listed above. These target facilities were identified essentially in a random manner, without any information concerning the likelihood of identifying evidence concerning human health or environmental damages.

These file searches did not provide any useful data for developing damage case summaries in Alabama and California. In Alabama, evidence of environmental damage or human health impact data was not identified in the state files reviewed for the target sites. Upon arrival in Sacramento, California, it was determined that inspection and enforcement documents, such as Notices of Violation, were not maintained at the state file room, but were available only at local district environmental protection offices. Subsequently, EPA contacted three local environmental agencies to seek data to develop damage case summaries. Within the available time and resources, however, EPA was unable to visit these offices or otherwise obtain information concerning any damage cases.

The Colorado Department of Health provided EPA with a bibliography of readily available files maintained at their offices in Denver. EPA visited the state offices and compiled three damage cases based on the available data.

EPA did not conduct file searches in New Jersey, Massachusetts, or Pennsylvania for a number of reasons. In Pennsylvania, environmental and human health information is maintained within the six State district offices. Because of the small number of sites in each district and the time required to set up and conduct a file search, these files were not examined. New Jersey also was not selected because of the long lead time required to set up a file review appointment at the State file room in Trenton. Finally, a file search was not conducted in Massachusetts because the State geologist was unable to identify any mining or mineral processing sites with known environmental or human health damages.

Obtaining EPA Region 10 Summaries

EPA contacted its EPA Region 10 staff who are responsible for overseeing the cleanup of mining and mineral processing sites in Alaska, Idaho, Oregon, and Washington to solicit their assistance in developing new damage case summaries. Region 10 staff prepared one damage case and provided supplemental information for a damage case also based on other sources.

In summary, EPA completed a limited three-step effort to identify 66 illustrative mining and mineral processing damage cases in a variety of mineral commodity sectors and states. Thus, these cases should not be seen as either an exhaustive survey or as a statistically representative sample of damage cases.

Summary of Damage Cases

This section describes the scope and variety of the damages presented in Chapter 2. Specifically, it discusses the mineral commodity sectors, geographic diversity, waste types, waste management practices, and damages covered by cases.

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Mineral Commodity Sectors

The damages described in this background document occurred at 66 facilities in the following 23 mineral commodity sectors:

- alumina
- antimony
- cadmium
- coal gas
- gold and silver
- iron and steel
- lithium
- molybdenum
- tantalum/columbium
- tungsten
- vanadium
- zirconium/hafnium
- aluminum
- boron
- cerium, lanthanides, and rare earths
- copper
- hydrofluoric acid
- lead
- mercury
- phosphoric acid
- titanium
- uranium
- zinc

These sectors encompass most of the major mining and mineral processing sectors affected by the proposed rule. These damage cases represent sites in 18 of the 31 sectors potentially affected by the proposed rule. Moreover, these 18 sectors account for most of the predicted costs that would be imposed by the proposed rule. For example, these sectors account for more than 90 percent of the estimated incremental land disposal restrictions (LDR) treatment costs under Option 2 under the no prior treatment baseline.[3] These sectors also cover all the major metal mining[4] and several non-metal mineral mining sectors.

Geographic Diversity

The 66 damage cases are for facilities located in 26 of the 50 United States. The states included are scattered across all regions of the nation, as shown in the table below.

[3] Exhibit 4-5, *Regulatory Impact Analysis of the Supplemental Proposed Rule Applying Phase IV Land Disposal Restrictions to Newly Identified Mineral Processing Wastes*, December 15, 1995, U.S. Environmental Protection Agency, Office of Solid Waste, page 4-16.

[4] See, for example, *Profile of the Metal Mining Industry,* supra footnote 2.

Exhibit 1. Damage Cases Are Located Throughout the Nation

Region of United States	States With Damage Cases Presented
North East/Mid-Atlantic	New Jersey, North Carolina, Pennsylvania, Virginia
South	Florida, Louisiana, South Carolina, Texas
Midwest/Central	Illinois, Kansas, Michigan, Missouri, North Dakota, Oklahoma, Ohio, South Dakota
Mountain West	Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah
West Coast	California, Oregon, Washington

These regions and states vary considerably in terms of their climate, from dry desert conditions to abundant rainfall, in their geology, and in their urban or rural characters.

Climate. The damage case facilities are located in climates that vary widely, such as the Taylor/Ward Project in the Nevada desert, which has about 4 inches of precipitation annually, to the Doe Run site in Missouri's Ozarks, which has an annual mean precipitation of about 46 inches.

Geology. The damage case facilities are also located in a wide range of environments. For example:

- ♦ The Tar Creek Site on the Kansas/Oklahoma border encompasses several mines that open into the Boone formation, a cherty limestone deposit averaging about 370 feet in thickness. Two dolomite layers lay below the Boone formation, and a layer of cherty dolomite with several sandy sequences is under these layers. Surface features are characterized by numerous tailings piles consisting primarily of limestone and chert.
- ♦ The Palmerton Zinc Site in Pennsylvania is situated at the confluence of the Lehigh River and Aquashicola Creek, just north of the Lehigh water gap. The site lies in a deep valley within the Appalachian Mountains, between Blue Mountain and Stony Ridge, which are 1,500 and 900 feet above sea level, respectively.
- ♦ The regional surficial and bedrock geology of in the vicinity of Texasgulf's Aurora, North Carolina site comprises a stratigraphy of approximately 150 feet of surficial soils overlying several hundred feet of limestone and marine sediments.
- ♦ The Nu-West facility in southeast Idaho is characterized by broad, flat valleys with base elevations near 6,000 feet. It is located at the eastern margin of the Blackfoot lava field. Bedrock beneath the site is basalt overlain by 5 to 25 feet of recent sediments.

Urban versus Rural Surroundings. The sites also vary in their nearby populations and associated real estate developments. For example:

- ♦ The Smuggler Mountain Site is within the city of Aspen, Colorado, which has a year-round population of 4,500. In many cases, development in the Aspen area has taken place directly over waste piles, or waste piles have been moved to the side of developed areas and remain as berms or mounds of contaminated soil. The site is approximately 90 percent developed as residential housing.

- The Glen Ridge, Montclair/West Orange, and U.S. Radium sites in New Jersey cover more than 200 acres of suburban and residential areas.
- The Torch Lake, Michigan area is a former copper mine boom town, which is maintained as a wildlife and recreational area. Sparely populated by year-round residents, many people own cottages at or near the lake which they use seasonally.
- The U.S. Titanium site in Virginia is set in a rural area populated by 200 people. Most residences are within a one mile radius of the site. The closest residence is 2000 feet to the west of the site.

Waste Types

The damage cases demonstrate that a wide assortment of extraction, beneficiation, mineral processing, and non-uniquely associated wastes are responsible for human health and environmental damages.[5] The wastes responsible for the damages are identified at the start of each damage case.

Damages have been caused by exempt as well as non-exempt wastes. Most of the damage cases, however, are linked to exempt mining or mineral processing wastes, for several reasons:

- One of the major sources for the cases, the 1990 *Report to Congress*, focused exclusively on exempt wastes.
- A second major data source, *Mining Waste Release and Environmental Effects Summaries*, focused on mining sites and mining wastes that are generally exempt from Subtitle C regulation under the Bevill Amendment.
- In addition, where damages are caused by mixtures of exempt and non-exempt wastes, the contribution of non-exempt wastes, which are likely to be much smaller in volume, may have been difficult to identify or otherwise were not identified.

Furthermore, in selecting damage cases to include in this document, EPA made no special efforts to include damages specifically caused by non-exempt mineral processing wastes. Thus, the limited number of damage cases directly linked to non-exempt mineral processing wastes cannot be taken to indicate the infrequency of such damages. Indeed, the cases include several examples of substantial human health and environmental damages caused by non-exempt wastes. See, for example, the damage cases for Ray Mines Complex, Arizona; Globe Paint, Denver, Colorado; Anaconda Smelter, East Helena Smelter, and U.S. Antimony, Montana; Palmerton Zinc, Pennsylvania; and U.S. Titanium in Virginia.

[5] For a description of potentially hazardous mineral processing wastes streams, see *Identification and Description of Mineral Processing Sectors and Waste Streams,* Section IV, December 15, 1995, U.S. Environmental Protection Agency. For a description of Bevill exempt mineral processing wastes streams, see the 1990 *Report to Congress*, Chapters 3-14. For a description of mining waste streams, see *Report to Congress on Wastes from the Extraction and Beneficiation of Metallic Ores, Phosphate Rock, Asbestos, Overburden from Uranium Mining, and Oil Shale*, 1985, U.S. Environmental Protection Agency.

For further information about the pollutants of concern in wastes from mining and mineral processing, see materials developed for EPA's storm water program, such as 58 *Federal Register* 61146, 61223-51, 61269-85 (November 19, 1993). Three of 11 categories of industrial facilities subject to storm water permitting requirements includes mining and mineral processing facilities:

- Metal mining (ore mining and dressing) facilities (SIC 10);
- Mineral mining and processing facilities (SIC 13); and
- Primary metals facilities (SIC 33).

The *Federal Register* notice cited above contains fact sheets for each of these three industries which discuss the industrial activities, including waste management practices, and the pollutants of concern potentially associated with each activity. These fact sheets describe the major activities representative of many of the facilities in these industries.

Waste Management Practices

The cases demonstrate that land-based management practices for mining and mineral processing wastes are responsible for considerable damages to human health and the environment. These damages commonly arise from land placement of wastes in unlined units having minimal engineered release controls. These units include piles of slags, dusts, refractory bricks, sludges, waste rock/overburden, and spent ore; surface impoundments containing mill tailings and/or process wastewaters; and heap leaching solution ponds. In addition, many, if not most of the damage case facilities have caused human health or environmental damages through leaks or spills, such as releases from lined management units, valves, and pipes. An attachment to this report, for example, summarizes available data on releases from the sites described in the *Mining Waste Release and Environmental Effects Summaries.* For more information on common waste management practices used for mining and mineral processing wastes, see the background document, *Identification and Description of Mineral Processing Sectors and Waste Streams, supra* footnote 5, and sources cited therein.

Human Health and Environmental Damages

The damage cases illustrate the wide variety of human health and environmental impacts caused by wastes from mining and mineral processing operations, including groundwater, surface water, and soil contamination, air deposition, human health damages or risks, and damages to vegetation, wildlife, and other biota. Most of the cases contain several types of impacts. The wide variety and frequency of damage is illustrated in the following chart, which is based on the readily information available; additional impacts may have occurred at the sites.

Exhibit 2.
Frequency of Various Types of Impacts

Type of Impacts	Portion of Damage Cases
Surface water contamination	70 percent of cases
Ground water contamination	65 percent
Soil contamination	50 percent
Human health impacts	35 percent
Flora and fauna damage	25 percent
Air deposition or fugitive emissions[a]	20 percent

[a/] Excludes releases associated with air pollution control requirements or devices.

Conclusion

The 66 damage cases presented in the following chapter of this background document illustrate the significant human health and environmental damages caused by the management of wastes from mining and mineral processing, particularly placement in land-based units. Both wastes that are subject to and, under the Bevill Amendment (RCRA §3001(b)(3)(A)(i-iii)), exempt from regulation as hazardous wastes under RCRA Subtitle C have caused these damages. The damages have occurred across the broad range of mineral sectors, including virtually all the sectors affected by the proposed supplemental rule to apply Phase IV land disposal restrictions to newly identified mineral processing wastes and make other regulatory changes. In addition, the damages have occurred throughout all regions of the United States, in a wide variety of climatic and geological zones and in both rural and urban areas.

CHAPTER 2. ILLUSTRATIVE DAMAGE CASES

Exhibit 3. (continued)
List of Damage Case Summaries from Mining and Mineral Processing Wastes

Arizona

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This chapter presents 66 cases of human health and environmental damages caused by mining and mineral processing wastes. These damage cases are alphabetically by state and within each state alphabetically by site name, as shown in Exhibit 3.

Exhibit 3.
List of Damage Case Summaries from Mining and Mineral Processing Wastes

State	Facility	Sector	Operating Status
Arizona	Ray Mines Complex	Copper	Active
California	American Girl Mine	Gold	Active
California	Carson Hill Gold Mine	Gold	Active
California	Grey Eagle Mine	Gold and silver	Active
California	Iron Mountain Mine	Copper, gold, silver, and zinc	Inactive
California	Jamestown Mine	Gold	Active
California	Mount Diablo Mine	Mercury	Inactive
California	Mountain Pass Mine and Mill	Lanthanide	Active
California	Pine Creek	Tungsten	Active
California	U.S. Borax Mine	Borax/borate	Active
Colorado	ASARCO Globe	Antimony, cadmium, copper, gold, lead, indium, silver, tellurium, and thallium	Active
Colorado	Clear Creek	Gold	Active
Colorado	Climax Mine	Molybdenum	Inactive
Colorado	Denver Radium	Gold and silver	Inactive
Colorado	Idarado Mine	Copper, gold, lead, silver, and zinc	Inactive
Colorado	Lincoln Park	Uranium, thorium, and vanadium	Inactive
Colorado	Rubie Heap Leach	Gold	Active
Colorado	Smeltertown	Lead, copper, silver, gold	Active

State	Facility	Sector	Operating Status
Colorado	Smuggler Mountain	Silver, lead, and zinc	Inactive
Colorado	Urad Mine and Mill	Molybdenum	Inactive
Florida	Bartow Chemical Plant	Phosphoric acid	Active
Florida	East Tampa Chemical Plant Complex	Phosphoric acid	Active
Florida	Plant City Chemical Complex	Phosphoric acid	Active
Idaho	Blackbird Mine	Copper and cobalt	Inactive
Idaho	Bunker Hill	Cadmium, lead, silver, zinc, phosphates, and sulfuric acid	Inactive
Idaho	Lucky Friday Mine	Gold, silver, lead, and zinc	Active
Idaho	Microgold II Mine	Gold	Inactive
Idaho	Nu-West Plant	Phosphoric acid	Active
Illinois	Illinois Zinc Plant	Zinc	Inactive
Kansas and Oklahoma	Tar Creek	Lead and zinc	Inactive
Louisiana	Allied-Signal Hydrofluoric Acid Plant	Hydrofluoric acid	Active
Louisiana	Arcadian Phosphoric Acid Plant	Phosphoric acid	Active
Louisiana	Faustina Works Phosphoric Acid Facility	Phosphoric acid	Active
Louisiana	Ormet Aluminum Plant	Alumina (bauxite)	Active
Michigan	Torch Lake Copper Mines	Copper	Inactive
Missouri	Doe Run Lead Smelter	Lead	Active
Missouri	Glover Lead Smelter	Lead	Active
Missouri	Oronogo-Duenweg Mining Belt	Lead and zinc	Inactive
Montana	Anaconda Smelter	Copper	Inactive
Montana	Basin Creek Mine	Gold	Active
Montana	Cable Creek Project	Gold and other precious metals	Active
Montana	East Helena Smelter	Lead and zinc	Active
Montana	U.S. Antimony Mine	Antimony	Active

State	Facility	Sector	Operating Status
Nevada	Nevada Moly Project	Copper and molybdenum	Inactive
Nevada	Taylor/Ward Project	Lead and silver	Active
New Jersey	Glen Ridge and Montclair/West Orange	Uranium, thorium, and vanadium	Inactive
New Mexico	Chino Mine	Copper	Active
New Mexico	Tyrone Mine	Copper	Active
North Carolina	Aurora Phosphate Plant	Phosphoric acid	Active
North Dakota	Great Plains Coal Gasification Plant	Coal gasification	Active
Northwest United States	Confidential Site	Phosphate	Active
Ohio	ASARCO Zinc Mine	Zinc	Inactive
Oregon	Martin Marietta Reduction Facility	Aluminum	Inactive
Oregon	Teledyne Wah Chang Albany	Hafnium, niobium, tantalum, vanadium, zirconium	Active
Pennsylvania	Aliquippa Works	Iron/steel	Inactive
Pennsylvania	Foote Mineral Company	Lithium	Inactive
Pennsylvania	Palmerton Zinc	Lead and zinc	Inactive
South Carolina	Brewer Gold Mine	Gold	Active
South Dakota	Gilt Edge Project	Gold	Active
South Dakota	Homestake Gold Mine	Gold and silver	Active
Texas	El Paso Plant	Copper, lead, and zinc	Active
Utah	Kennecott North	Copper	Active
Utah	Kennecott South	Copper	Active
Utah	Monticello Mill	Uranium and vanadium	Inactive
Virginia	U.S. Titanium	Titanium	Inactive
Washington	ASARCO Tacoma Smelter	Copper	Inactive

Note: The "Operating Status" listed for each of the facilities in Exhibit 3 is taken from either (1) the summary write-ups in this chapter, (2) Randol International Ltd's. *Mining Directory 1994/95, U.S. Mine and Mining Companies*, Golden, CO 1994, or (3) EPA's *Identification and Description of Mineral Processing Sectors and Waste Streams, Technical Background Document*, Appendices F and G, December 15, 1995. The accuracy of a facility's reported operating status is limited to the files reviewed.

Ray Mines Complex: UST Leak, PCB and Acid Spills, and Wastewater Transfer

Sector: Copper

Facility: Ray Mines Complex (Hayden Plant), ASARCO, Gila County, AZ

Facility Overview: A copper smelting facility. No mining or beneficiation took place on-site.

Waste Stream(s): Electric slag cleaning vessel (ESCV) slag, acid plant blowdown, brine concentrator blowdown, and other process wastewater.

Waste Management Practices: The facility had 17 surface impoundments, including a rubberized-asphalt lined wastewater treatment pond. ESCV slag containing iron, silica, and other constituents was placed in piles on-site. Acid plant blowdown containing calcium sulfate sludge was neutralized with lime and mixed with silica to produce a flux suitable for use in the flash smelter. Brine concentrator blowdown was the only process wastewater discharged to the lined wastewater treatment pond. Other wastewater was generally handled by the wastewater treatment plant. Until 1990, the lined wastewater treatment pond received acid plant blowdown to settle out the calcium sulfate sludge. Sludge continued to be excavated from the water treatment pond to recover trace amounts of copper. Other process wastewater was discharged to a central lagoon, separate from the wastewater treatment plant pond. Other waste management units at the Hayden Plant included a solid waste landfill, a drum storage area, and an asbestos landfill.

In December 1990 and January 1991, large quantities of wastewater were pumped from the lined wastewater treatment pond into an unlined pond to prevent overflowing due to large amounts of rainfall. ASARCO reported that the transferred water was of the quality normally received by the unlined pond.

Type of Impact/Media Affected: Releases of contaminants to the environment had occurred at the facility through leaks from underground storage tanks (USTs) containing gasoline and diesel fuel, a spill of polychlorinated biphenyl, and a spill of 20 tons of sulfuric acid. The leaking USTs contaminated soils with aromatic constituents (benzene, toluene, and xylene (BTX)) at levels exceeding the Arizona Health Based Guidelines. The PCB spill contaminated an area comprised of soil, a concrete pad, the perimeter fence, railroad tracks, and a vehicle adjacent to the concrete pad. Employees spread a clay absorbent to dry up the spill, and all contaminated material was placed in drums and isolated with the contaminated vehicle.

Regulatory Actions/Environmental Claims: The Hayden Plant was issued a National Pollution Discharge Elimination System (NPDES) permit effective January 30, 1983 through November 11, 1987. The permit allowed ASARCO to discharge cooling tower blowdown to the Gila River. In October 1984, the Arizona Department of Health Services informed ASARCO of deficiencies in monitoring and reporting of its Hayden Plant wastewater treatment system. EPA Region 9 issued a Finding of Violation and Order to ASARCO in May 1985 for a low Ph condition in the acid plant effluent discharged to the Gila River. The Order required immediate remediation, monitoring, and future NPDES compliance. After a period of satisfactory compliance, EPA terminated the Order. No information was provided in the reference on any regulatory action resulting from the UST leak or the chemical spills mentioned above.

References: U.S. EPA. Draft. *Mining Waste Releases and Environmental Effects Summary for the State of Arizona*. March 1994.

American Girl Mine:
Two of Three Releases Were Contained

Sector: Gold

Facility: American Girl Mine, American Girl Mining Corporation, Imperial County, CA

Facility Overview: This facility consisted of a surface mine and mill and at least two heap leach pads. The main processes were cyanide heap leaching and processing.

Waste Stream(s): Mine water, waste rock, spent ore, and spent leaching solution.

Waste Management Practices: A weak solution of sodium cyanide was distributed across the top of the heap of crushed gold ore. The solution was collected and treated to remove the gold then recycled back to the heap. The leaching ponds were lined and utilized leak detection systems.

Type of Impact/Media Affected: During the week of December 6, 1987, 1,700 gallons of pregnant solution leaked into the pregnant pond detection sump and were contained by the underliner. Three leaks were located and repaired.

On February 29, 1988, the facility discovered a leak at a new leach pad. An estimated 4,320 to 8,640 gallons of solution containing 4.68 to 9.36 pounds of cyanide were released. The spill was isolated immediately and the leak repaired. Clay liners were assumed to have contained the leak.

On August 4, 1989, a heap pile return hose became disconnected. Crushed ore became saturated and weakened, causing a slope failure releasing ore and pregnant solution outside the containment berm and liner. The material was returned to the pad, while some areas were treated with dry hypochlorite to destroy any cyanide. Laboratory tests of soil samples by a California Registered Environmental Assessor led to the conclusion that all of the contaminated soils were removed.

Regulatory Actions/Environmental Claims: The operator provided notice to the state when the releases described above occurred. No information was gathered on any enforcement actions taken as a result of any of the releases.

References: U.S. EPA. Draft. *Mining Waste Releases and Environmental Effects Summaries for the State of California.* March 1994.

Carson Hill Gold Mine:
Cyanide Solution Spills Into Reservoir

Sector: Gold

Facility: Carson Hill Gold Mine, Western Mining Corporation, Calaveras County, CA

Facility Overview: This facility conducted open pit gold mining and beneficiation. The site included three heap leach piles, pregnant and barren ponds, and a processing plant for carbon adsorption.

Waste Stream(s): Waste rock, mine water, spent ore, and spent leaching solution.

Waste Management Practices: The normal flow of operations at the site was as follows:

- Mined ore was crushed and transferred to the leach heaps.
- Alkaline cyanide solution from the barren pond was applied to the ore heaps, dissolving gold in the ore as it percolated down through the heap.
  - Leachate was piped from the periphery of the pads for transfer to the pregnant ponds.
  - Pregnant solution from the pregnant ponds was pumped to the plant for gold recovery.
  - Finally, spent solution was returned to the barren pond, completing the circuit.

Prior to 1988, two leach units (Unit 1 and Unit 2) were in operation. A third unit was constructed in 1988, and Unit 2 was extended in 1989. Unit 1 received no ore after late 1989 and began detoxification for final closure with fresh water rinsing and recirculation.

Type of Impact/Media Affected: On May 16, 1989, 91,450 gallons of pregnant solution were accidently discharged from Unit 3 into the nearby Melones Reservoir. Soils along the drainage between the facility and the reservoir were contaminated. The spill was caused by a loose pipe coupling in the leachate containment system above a spillway outlet. Because the spillway terminated outside the fluid management system, the release travelled beyond facility boundaries into the reservoir. Sampling of reservoir water six hours after the spill detected free cyanide levels below 0.1 mg/L. Further sampling eight days after the spill yielded no trace of cyanide or other metals above background levels.

Regulatory Actions/Environmental Claims: After assessing the extent of the release, Carson Hill staff notified the appropriate federal and state agencies, including the California Regional Water Quality Control Board, the California Department of Fish and Game, the Bureau of Land Management, and EPA's National Response Center. No information was gathered on any regulatory actions taken as a result of the 1989 spill.

References: U.S. EPA. Draft. *Mining Waste Releases and Environmental Effects Summaries for the State of California.* March 1994.

Grey Eagle Mine: Faulty Dam Plagues Operation

Sectors: Gold and silver

Facility: Grey Eagle Mine, Noranda, Siskiyou County, CA

Facility Overview: This facility, which operated from 1982 to 1986, excavated, crushed, and extracted metals from ore using the carbon-in-pulp leach method. Beneficiation entailed adding water, flocculants, lime, sodium hydroxide, activated carbon, and sodium cyanide to the ore.

Waste Stream(s): Tailings.

Waste Management Practices: Tailings were deposited as a slurry in the tailings impoundment in the dammed canyon of the South Fork of Luther Gulch Creek. The dam was designed to prevent pollutant transport from the containment reservoir. Creek flows were diverted around the reservoir, which contained approximately 827,000 tons of tailings.

Type of Impact/Media Affected: In early February 1983, shortly after commencing operations, site inspections revealed that the toe of the impoundment dam was leaking. Two drainage pipes were discharging solution with high amounts of cyanide and acidic pH levels, flowing at rate of 15 to 30 gallons per minute. By April 1983, a permanent pumping system and seepage treatment infrastructure were operating at the toe of the dam. Initially, pumps redirected the seepage back into the impoundment reservoir. Later, pumpback was limited to weekends only, since the facility planned to cap the reservoir upon closure and install facilities to treat all seepage. The reservoir was capped in 1987. A seepage treatment system was built; it consisted of a slurry wall for containment, a French drain system for collection, a treatment plant, and a leachfield for waste disposal.

The site experienced several accidental discharges over its four-year operating life, with most, though not all, spills being related to the facilities constructed to treat and dispose of the toe-of-dam seepage. Unrelated spills included a line rupture on January 4, 1983, resulting in a spill of on-site, recycled tailings dam water containing high levels of cyanide. Between 1,000 and 1,500 gallons of solution were released; the discharge, however, was captured in a sedimentation pond and treated. On June 8, 1986, a surge storage tank overflowed at 35 gallons per minute. The discharge was detected the following morning and pumps at the collection well started and the discharge ceased. Approximately 19,100 gallons were discharged directly into Luther Gulch Creek. Water sampling that day detected cyanide and copper levels exceeding both state and federal standards 1.5 miles downstream.

In February 1989, two small spills occurred. On February 23, untreated water seeped out of a surge tank due to a faulty discharge nipple. The nipple was replaced the following day. On February 24, a corroded metal pipe discharged untreated reservoir seepage containing traces of cyanide, high levels of copper, and a low pH at 2-3 gallons per minute for several hours.

Regulatory Actions/Environmental Claims: On February 23, 1983, after discovery of the dam seepage, the California Regional Water Quality Control Board (CRWQCB) issued Cleanup and Abatement Order No. 83-27. The Board issued a Cease and Desist Order (No. 83-55) in September after five months of public hearings and monitoring, citing Noranda with discharging hazardous waste in violation of its original permit. On October 26, 1983, Noranda paid the CRWQCB $8,233.34 in fines in lieu of action by the State Attorney General. A new WDR permit, Order No. 84-49, was issued May 31, 1984, deferring action on the previous Cease and Desist Order. On July 26, 1984, however, a new Cease and Desist Order was issued (No. 84-49) specifying new dates for controlling dam seepage.

In July 1986, Noranda was fined $12,000 as part of an Administrative Civil Liability for its June 8-9, 1986, spill.

In February 1987, Noranda applied to the Department of Health Services for a classification of its tailings as non-hazardous waste. The request was denied.

References: U.S. EPA. Draft. *Mining Waste Releases and Environmental Effects Summaries for the State of California.* March 1994.

Iron Mountain Mine: Uncontrolled Release Kills 200,000 Salmon

Sectors: Copper, gold, silver, and zinc

Facility: Iron Mountain Mine, CA

Facility Overview: Iron Mountain Mine extracted copper, silver, gold, zinc, and pyrite minerals from 1865 to 1963, when all mining at the site was discontinued. In recent years, metal recovery activity at the site has been limited to extracting copper from acid mine drainage using copper cementation.

Waste Stream(s): Tailings.

Waste Management Practices: Copper and pyrite ore tailings from a copper flotation mill operated between 1914 and 1919 were disposed at a facility in the Town of Minnesota, approximately two miles east of the site. A tailings dam was constructed in Slickrock Creek in the late 1920s; it was destroyed by a flood in 1933. Open-pit mining of gold and silver in the Old Mine area resulted in tailings disposal in Hogtown Gulch, adjacent to Slickrock Creek. A cyanide leach plant was built in this area in 1929. In 1963, the Spring Creek Debris Dam was built to control the discharge of contaminated run-off into the Sacramento River. Releases from Spring Creek Reservoir were coordinated, when possible, with releases from Shasta Lake to dilute the heavy metals.

Type of Impact/Media Affected: Sources of pollutants from the site included the cementation plants, tailings piles, waste rock dumps, and seeps. Tailings in the Minnesota Flats area contributed to contamination of Flat Creek. Acid mine drainage was created by the infiltration of rain water and the migration of ground water through the massive sulfide mineral zone. As the water passed through the ore, sulfuric acid was produced. Copper, zinc, and cadmium were leached from the mineralized zone by the acidic water (pH of 0.5). The acid mine drainage was eventually discharged through mine exits or by ground water seepage into streams in the Spring Creek watershed. In general, acid mine drainage generation was seasonal and was accelerated during periods of heavy rainfall.

Surface water pollution resulted in heavy metal bioaccumulation in fish and contamination of the Sacramento River, Redding's drinking water supply. As a result of surface water and ground water discharges, Slickrock Creek, Boulder Creek, and Flat Creek were devoid of aquatic life. In addition, heavy rains in 1969 caused uncontrolled releases of contaminated water from Spring Creek Reservoir which killed approximately 200,000 salmon. Acid mine drainage from Iron Mountain Mine was one cause of a drastic decline in King Salmon as well.

Regulatory Actions/Environmental Claims: Initial concern about pollution of the site started as early as 1902, when property owners and the U.S. Forest Reserve sued the mine owner, Mountain Copper, for vegetation destruction caused by the Keswick Copper Smelter. Concern for the watershed destruction began in 1928, when the California Fish and Game Commission filed complaints about the Slickrock Creek Tailings Dam.

A Record of Decision in 1986 authorized interim remedial actions of capping, surface water diversion, and enlargement of the Spring Creek Debris Dam. EPA issued two Unilateral Orders, the first was an order for temporary treatment in 1989. The second order required the Potentially Responsible Parties to perform remedial actions in Upper Spring Creek.

References: U.S. EPA. Draft Final. *Mining Sites on the National Priorities List: NPL Site Summary Reports. Volume II.* June 21, 1991.

Jamestown Mine: Plagued by Numerous Spills

Sector: Gold

Facility: Jamestown Mine, operated by Sonora Mining Corporation and Pathfinder Gold, Tuolomne County, CA

Facility Overview: The gold mining operation and mineral extraction facility began operating in 1986. Units at the site included the mill, four open mine pits, waste rock piles, low-grade ore storage piles, a tailings management system, interconnecting roadways, and ancillary facilities.

Waste Stream(s): Waste rock, tailings, and spent leaching solution.

Waste Management Practices: Four to 7,000 tons of ore per day were crushed and concentrated at the mill. The concentrate was either vat leached on-site or transported to other Sonora Mining facilities for processing. Crushed ore was separated into concentrate ore and tailings using a standard flotation method. Gold was removed from the concentrate in the vat leaching system using thiourea and other reagents, excluding cyanide and mercury. Leached and flotation tailings were disposed of in the tailings management facility, which consisted of a tailings pond, complete with drainage equipment and liners, and an associated retention pond. Water in the retention pond was treated and discharged to surface waters under an NPDES permit (NPDES permit No. CA0081698, CRWQCB Order No. 88-110).

Type of Impact/Media Affected: Numerous spills and releases have occurred at the site including the following:

- Spills within the mill building that were not contained by the building:
    - Approximately 500 gallons of flotation solution were spilled on January 2, 1987, with 200 gallons flowing out of the building into a sediment pond. Samples taken that day indicated concentrations of the flotation compounds were below detectable levels.
    - A fire on January 16, 1987, occurred at the reagent day tank area of the mill. All electrical power to the mill was shut off. The fire damaged tanks and pipes carrying various reagents, causing them to leak. While most of the solutions were contained within the building, 2,700 gallons escaped, but were captured in a temporary earthen sump.
- Spills that have occurred on mine property as a result of equipment failure:
    - A 1,000 gallon release of process water on May 7, 1989. The spill was contained quickly, with no reported environmental damage.
    - Approximately 1,500 to 2,000 gallons of tailings slurry were released on July 10, 1990 when an emergency diversion system for the tailings line became overpressurized. This spill was contained on-site.
    - A soda ash mixing tank overflowed on July 21, 1990, spilling approximately 3,000 gallons of 1.5 percent soda ash solution into a tailings pond.
    - A leak was discovered in a buried high pressure line carrying filtered process water on September 6, 1990. Approximately 1,500 gallons were released before the line was repaired.

- Spills have also occurred at the tailings management facility and from trucks transporting materials from the mine for processing elsewhere.

In all cases, the mechanical causes of the spills have been repaired or replaced. All waste have been contained and returned to the site; all water was collected by sumps and returned to the appropriate portion of the facility.

Regulatory Actions/Environmental Claims: No information was gathered on any regulatory actions taken as a result of these spills.

References: U.S. EPA. Draft. *Mining Waste Releases and Environmental Effects Summaries for the State of California*. 1994.

Mount Diablo Mine: Mercury From Mine Found in Local Streams, Park

Sector: Mercury

Facility: Mount Diablo Mine, bordering Mount Diablo State Park, Contra Costa County, CA

Facility Overview: The facility conducted mining and milling from the late 1920s through the late 1950s. The site consisted of tailings, overburden, waste rock piles, and three ponds. Tailings and overburden were also found on adjacent park land.

Waste Stream(s): Tailings, waste rock, and mine water.

Waste Management Practices: No information was gathered on the specific types of waste management practices that had occurred at the site.

Type of Impact/Media Affected: Run-off from tailings and waste rock entered directly into the ponds as well as into adjacent Horse and Dunn Creeks. Environmental impacts from the facility had been documented since the late 1970s. During an inspection by State Department of Fish and Game personnel in July 1978, the owner indicated his intent to divert spring water from the tailings and overburden storage areas and discharge it into Dunn Creek. State officials advised the owner such action would violate state laws. At a follow-up inspection the next month, however, the California illegal discharge was observed and noted as being "extremely lethal." The owner submitted a plan to comply with regulations. A Clean-up and Abatement Order requiring cessation of the discharge was ordered November 20, 1978. No information was gathered to indicate whether the deadline was met.

On March 9, 1988, and July 14, 1988, the state took samples from Horse Creek along the border between the mine and park property. The sample revealed near hazardous levels of mercury, resulting from seepage and run-off from the tailings, waste rock, and overburden. In addition, the soil was discolored (red from iron oxides, yellow from sulfur), the air smelled of sulfur, and the creek frothed, probably from iron flocculation. This iron was likely leached from the tailings and overburden.

During a 1989 state sampling inspection, the main pond had a pH level of 3.01. Although an outlet to a connecting pond was constructed to reduce the possibility that the main pond would overflow, state officials worried that a heavy rain could result in the pond overflowing into Horse and Dunn Creek, causing adverse environmental effects.

Regulatory Actions/Environmental Claims: California issued a Clean-up and Abatement Order in response to the unpermitted discharges observed in 1978. During 1988-1989, the California Water Quality Control Board was working with both the owner and the Department of Parks and Recreation to address the contamination. No information was gathered on any enforcement actions taken during this period.

References: U.S. EPA. Draft. *Mining Waste Releases and Environmental Effects Summaries for the State of California*. March 1994.

Mountain Pass Mine and Mill:
Lanthanide Mine Contaminating Ground Water

Sector: Lanthanide

Facility: Mountain Pass Mine and Mill, Molycorp Incorporated, San Bernandino County, CA

Facility Overview: The site had been operating as an open pit lanthanide mining, beneficiation, and processing facility since 1950. Mine waste (overburden) was held on-site, and numerous process water, tailings, and product storage ponds were operated.

Waste Stream(s): Process water and tailings.

Waste Management Practices: Mine waste overburden was stockpiled on-site. From 1950 to 1980, wastewater from the mill was disposed of in on-site percolation-type surface impoundments. In 1980, two 40-acre evaporation ponds were constructed on Ivanpah Dry Lake.

Type of Impact/Media Affected: Ground water samples taken in 1985 indicated increasing total dissolved solids levels in the ground water below the lakebed. At that time the evaporation ponds were determined to be leaking, due to mechanical failure. In 1988, the leaking ponds were replaced with a 100-acre wastewater evaporation pond. Ground water remediation was being accomplished through installation of interceptor wells. Continuous ground water extraction had occurred since 1980. More wells were to be constructed. Several of the former waste disposal ponds had been clean closed. The company was investigating methods for sealing or reconstructing several of the active holding ponds to eliminate leakage.

Two wastewater spills had also been documented at the site.

- On May 26, 1989, approximately 3,375 gallons spilled from a damaged pipeline carrying tailings water and effluent from the separation plant. The spill was contained in an on-site stormwater run-off pond.

- In late August 1990, approximately 45,000 gallons of wastewater spilled from a surge tank when trash from plants further up the line clogged a valve in the main line below the holding tank. The spill was contained by the facility's surface/ground water collection system.

No remedial measures had been proposed to correct any contamination caused by the two surface spills, as these spills were contained on-site and not believed to pose a significant threat to human health or the environment.

Regulatory Actions/Environmental Claims: On November 4, 1985, the California Regional Water Quality Board notified Molycorp that certain surface impoundments on-site contained hazardous waste and were covered under the Toxic Pits Cleanup Act (TPCA). As of 1994, only the surge pond had been determined to be covered by TPCA.

References: U.S. EPA. Draft. *Mining Waste Releases and Environmental Effects Summaries for the State of California.* March 1994.

Pine Creek: Tungsten Mill Leaks Pollutants into Nearby Stream

Sector: Tungsten

Facility: Pine Creek Operations, U.S. Tungsten Corporation, Inyo County, CA

Facility Overview: This site conducted tungsten mining and milling, including crushing and grinding ore, flotation concentration, pressure leaching, molybdenum precipitation, solvent extraction, and ammonium paratungstate precipitation.

Waste Stream(s): Boiler blowdown, tungsten mill tailings, and wastewater.

Waste Management Practices: Mine drainage was used for mill make-up water. Approximately 1.5 million gallons per day of tailings were discharged from the mill to four tailings ponds. Effluent from several septic tanks located throughout the mill site were added to the tailings discharge. An additional 2,500 gallons per day of boiler blowdown were added to the tailings discharge. The four tailings ponds, covering 90 acres between Pine Creek and the northern canyon wall, were unlined and contained more than 15 million tons of tailings deposited over more than 40 years. Also, an unlined decant pond and three percolation ponds received decant water from the tailings ponds.

Type of Impact/Media Affected: On February 21, 1990, routine sampling and analysis of the receiving waters of the Pine Creek Drainage showed an increase in the amount of total dissolved solids (TDS). In response to the finding, U.S. Tungsten profiled the entire stream to determine the source of the problem. This effort revealed that sodium and sulfate, major elements of U.S. Tungsten's waste stream from the ammonium paratungstate plant, were the primary contributors. The company determined that there was a leak in an underground distribution line but was unable to determine the duration of the problem. They did, however, estimate that 2,419 gallons per day, or 2,622 pounds per day of TDS, were being released to Pine Creek. A spill report was filed by U.S. Tungsten on March 6, 1990, with an addendum filed on March 11.

All waste stream flow from the leaking distribution line was stopped, and the line was filled with concrete. A monitoring program was implemented until April 11, 1990, when TDS levels returned to the limits set forth in the basin plan.

Regulatory Actions/Environmental Claims: No information was gathered on any regulatory actions taken at this facility.

References: U.S. EPA. Draft. *Mining Waste Releases and Environmental Effects Summaries for the State of California*. March 1994.

U.S. Borax Mine:
Polluting Ground Water

Sectors: Borax/borate

Facility: U.S. Borax Mine, Kern County, CA

Facility Overview: U.S. Borax operated a borax mine, a refinery, and a boric acid plant. The facility included 13 surface impoundments for evaporation and precipitation of recoverable secondary sodium borate and other constituents.

Waste Stream(s): Process wastewater and solids.

Waste Management Practices: Waste liquids and solids from the refinery and boric acid plant were pumped to surface impoundments for evaporation and precipitation of secondary sodium borate and other constituents. Of the 13 impoundments at the facility, three were unlined, five had clay liners, and five were fully lined. Past disposal practices allowed wastewater in these impoundments to overflow the clay lined (or unlined) surfaces and percolate through the upper portions of the dikes.

Type of Impact/Media Affected: Releases to ground water from the impoundments were discovered in 1975. Wastewater had migrated into the vadose zone, resulting in saturated conditions below the units.

CRWQCB Order No. 6-90-37, issued March 9, 1990, required U.S. Borax to conduct quarterly ground water monitoring. Results from the 1990 third quarter indicated total dissolved solids (TDS) concentrations underlying the units exceeding background levels by up to three orders of magnitude, in some cases exceeding 4,000 mg/L. Arsenic concentrations in on-site ground water exceed the MCL standard of 0.05 mg/L.

On July 30, 1990, a spill occurred at the facility as a result of an 8 to 10 inch lengthwise split in a section of underground piping used to pump wastes to the surface impoundments. Arsenic-bearing waste bubbled to the surface into a shallow ditch. This release continued for an extended, though unspecified, period of time at a rate of 300 gallons per minute. A vacuum truck was used to recover 42,000 gallons of wastewater, while the soil was to be sampled and returned to the refinery for borate recovery. No data were gathered on whether these actions were actually taken.

In 1985, the unlined ponds were taken out of service. All impoundments being used at the site had clay liners. In addition, subdrains lay below the liners; they discharged to leachate collection sumps. As of 1994, there were no known releases to the vadose zone or ground water.

A series of interceptor wells were installed in 1985 approximately 1/2 mile downgradient of the facility. Continuous pumping of these wells stopped in 1989 when hydrogeologic testing determined that the perched ground water mound was being pulled rather than intercepted.

Regulatory Actions/Environmental Claims: A Compliant/Spill Report Form was filed by the Kern County Fire Department for the 1990 spill. U.S. Borax submitted a follow-up report to the county. No further regulatory actions were taken as a result of this incident.

References: U.S. EPA. Draft. *Mining Waste Releases and Environmental Effects Summaries for the State of California*. March 1994.

ASARCO Globe: Metals Polluted Ground Water and Soil

Sectors: Antimony, cadmium, copper, gold, lead, indium, silver, tellurium, and thallium

Facility: Globe Paint, ASARCO, Denver, CO

Facility Overview: Smelter operations began in 1886 producing gold, silver, lead, and copper. In 1901, the plant was converted to lead smelting. In 1921, lead smelting was replaced by arsenic trioxide production, which continued until 1926. The plant was then converted to produce cadmium, litharge, test lead, and occasionally thallium, indium, and other high purity metals such as antimony, copper, and tellurium. Cadmium production ceased in 1993.

Waste Stream(s): Slag and process wastewater.

Waste Management Practices: Liquid and solid wastes were initially disposed at several locations on the site, generally near where they were generated, as fill material, in piles, and as liquid discharge to the ground surface or to a sedimentation pond. From approximately 1901 to 1919, lead blast furnace slag was disposed in the northeast corner of the site. During the 1930s, spent electrolyte solution may have been discharged directly to the ground surface on-site. Between 1948 and 1986, liquid wastes were discharged to the Former Neutralization Pond. Until 1993, process wastewater was treated on-site and discharged to the Denver Metro Wastewater utility sanitary sewer system. ASARCO has recently maintained an on-site treatment facility for ground water. After treatment, the ground water has been discharged to the Denver Metro Wastewater utility sanitary sewer system. Sludge from treated ground water was shipped off-site to ASARCO's East Helena (MT) site.

Type of Impact/Media Affected: The approximately 89 acre site is situated along the west edge of the South Platte River floodplain. Although most of the site is between 30 and 60 feet above the floodplain, the slag deposit was located in the floodplain. The slag deposit was approximately 15 feet thick, up to 300 feet wide, and 1,100 feet long. The precipitates, which were disposed of and have formed sediments in the Former Neutralization Pond, ranged from 11 to 17 feet in thickness and covered approximately 7 acres.

Sitewide, the contaminants of concern that were released to soil and ground water were arsenic, cadmium, lead, and zinc. Much of the shallow ground water beneath the site contained elevated concentrations of dissolved cadmium and zinc. Although the surficial ground water was not a source of municipal drinking water, several domestic wells in the vicinity were contaminated.

Sources of contamination included the fill materials, the former sedimentation pond, and the Former Neutralization Pond. A smaller arsenic plume coincided with the location of the former arsenic production facility. Another localized arsenic plume was detected below the precipitate in the Former Neutralization Pond. Surface water and sediments in on-site retention ponds were contaminated from ground water seepage.

Shallow soil, both on and off-site, had concentrations of cadmium, arsenic, lead, and zinc exceeding background levels. Although these levels decreased with depth and distance from the site, they were perceived as presenting a potential health hazard to the nearby public, Globeville community, especially children. Within one mile of the site, concentrations of these metals in vegetable garden soils were typically elevated.

Regulatory Actions/Environmental Claims: In 1980 and 1981, the Colorado Department of Health (CDH) found the site to be out of compliance with the Colorado Solid Waste Disposal Sites and Facilities Act. EPA listed the site on the open dump inventory for 1981 under RCRA Section 4000 criteria. In December 1983, CDH sued ASARCO for damages to natural resources under CERCLA. In 1986, CDH issued an Administrative Compliance Order (CO) against ASARCO alleging violations under the Colorado Hazardous Waste Management Act. The CO was resolved in 1987 under a Compliance Order Upon Consent. Later in 1987, the State and ASARCO entered into a Memorandum of Agreement (MOA) to conduct joint studies to assess cleanup of the site.

In March 1992, the State and ASARCO entered into an Agreement in Principle/Principles of Agreement (AIP/POA) which superceeded the MOA and set forth a proposal for ASARCO to remediate the site and pay for past and future state costs and damage to natural resources. In July 1993, the United States District Court in Denver issued a Consent Decree that superceeded the AIP/POA and included the stipulations and other agreed-upon elements for cleanup as stated in previous documents, studies and investigations.

Actions taken to date have included capping the Former Neutralization Pond in 1986, constructing a new wastewater treatment plant in 1986, repairs to the Farmers and Gardeners Ditch in 1987 and 1988, and constructing a ground water interceptor drain in 1988. Additionally, a large, local housing project nearby was closed and its residents relocated due to contaminated soils.

References:
Record of Decision, Asarco Globe Plant Site Denver, Colorado. Colorado Department of Health, February 18, 1993.

Globeville Childhood Metals Study: An Exposure Study Denver, CO. Colorado Department of Health Division of Disease Control and Environmental Epidemiology, February 1994.

Public Health Evaluation. Colorado Department of Health, undated.

Clear Creek: Old Mine Waste Tunnels and Tailings Erosion Cause Contamination

Sector: Gold

Facility: Clear Creek, Central City, Clear Creek and Gibsin Counties, CO

Facility Overview: Gold mining activity began in 1859 with the discovery of placer gold at the mouth of Chicago Creek, a tributary to Clear Creek. By the summer of 1860, almost all surface lodes had been claimed.

Waste Stream(s): Acid mine drainage, mine waste, and tailings piles.

Waste Management Practices: Waste management practices included disposing of waste and tailings piles near where they were generated, and allowing mine drainage water to flow into existing surface water features. As a result of extensive mining activity on a large number of small mining claims, wastes were disposed in numerous small-volume waste rock and tailings piles distributed over a wide area. In addition, a large number of tunnels drained water from the mines.

Type of Impact/Media Affected: Surface waters at the site were contaminated by direct discharges from both mine drainage tunnels and eroding mine waste piles. Contaminants have included aluminum, arsenic, cadmium, chromium, copper, fluoride, lead, manganese, nickel, silver, zinc, and the indicator pH. The presence and concentration of these contaminants has varied over time and location within the site. Contaminated areas have included North and West Clear Creek, Chicago Creek, Lion Creek, and Soda Creek.

Ground water samples taken from 14 drinking water wells and 19 monitoring wells in the area indicated elevated concentrations of metals at many locations. Several of the monitoring wells and one of the drinking water wells contained concentrations that exceeded drinking water standards. Both soil and air quality were contaminated by tailings piles, sedimentation from runoff, and airborne dust. These impacts were generally localized and occurred near mine waste and tailings piles.

Regulatory Actions/Environmental Claims: Removal actions have included emergency installation of a retaining wall to support a tailings pile, removal of several tailings piles and contaminated soil and sediment, control of acid mine drainage, and provision of bottled water to several homes that used contaminated water. These homes were later connected to a municipal water supply system. Remedial actions completed to date include erosion and stormwater controls, slope stabilization, streambank removals, and capping of tailings, all at various locations within the site.

References:

Record of Decision Clear Creek/Central City Superfund Site Operable Unit #3 Gilpin and Clear Creek Counties, Colorado. United States Environmental Protection Agency Region VIII and Colorado Department of Health, September 30, 1991.

Argo Tunnel Site Inspections/Progress Reports. Colorado Department of Public Health and Environment.

National Tunnel Site Inspections/Progress Reports. Colorado Department of Public Health and Environment.

Climax Mine:
Molybdenum Mine Tailings Blown Off-Site

Sector: Molybdenum

Facility: Climax Mine, AMAX Mineral Resources Company, Lake, Eagle, Summit, and Park Counties, CO

Facility Overview: The Climax Mine produced molybdenum disulfide from molybdenite ore, primarily from an open pit. The site covered approximately 11,600 acres of contiguous land, though it had operated at a very small percentage of its capacity. Site operations began in 1918.

Waste Stream(s): Tailings.

Waste Management Practices: Tailings from flotation were transported in a water slurry via tailings pipelines to ponds located north of the mill. After entering the ponds, tailings sands settled out, the water was decanted, and then pumped back to the mill as part of the recycled water circuit. The tailings were comprised mostly of silica.

Type of Impact/Media Affected: High winds had carried loose tailings dust from the impoundments and dam off-site, causing poor visibility and tailings accumulations. The phenomena had been called a "horizon white-out."

Regulatory Actions/Environmental Claims: On December 2, 1986, the Colorado Mined Land Reclamation Board issued NOV Number M-86-085 to AMAX, and ordered AMAX to continue to stabilize the ponds and dams and to submit a tailings stabilization plan. Two inspections and citizen reports were used as evidence in citing AMAX with violating the terms of its operating permit (#M-77-493) as well as C.R.S. 34-32-116 (1)(j). AMAX was ordered to work with the Colorado Department of Health and the Mined Lands Reclamation Division to stabilize the problem areas and submit a stabilization plan within 60 days. A civil penalty was also levied in the amount of $4,000, but a subsequent settlement agreement dropped the fine. An Agreement, Stipulation, and Order dated December 18, 1986, vacated the original NOV and waived the fine. Instead, AMAX was ordered to submit an application to incorporate their October 30, 1986, control plan to their permit. AMAX submitted a revised dust suppression control plan with the long-term goal of treating and revegetating areas for stabilization.

References: U.S. EPA. Draft. *Mining Waste Release and Environmental Effects Summary for the State of Colorado*. March 1994.

Denver Radium: Gold and Silver Mining Wastes Heavily Contaminate Soil

Sectors: Gold and silver

Facility: Denver Radium (Robinson Brick), Denver, CO

Facility Overview: In 1886, the Bailey Smelter began operation on this site. In 1890, the Gold and Silver Extraction Company established a mill and laboratory to process ore. In 1902, the Colorado Zinc Company constructed a mill which operated until 1911. In 1913, the National Radium Institute began milling operations which continued through 1918.

Waste Stream(s): Radium contaminated wastes and dusts.

Waste Management Practices: The site includes approximately 31 properties where radium contaminated waste was discarded when the facility closed. A total of approximately 106,485 cubic yards of contaminated soil was left behind. In 1988, excavation and permanent off-site disposal of contaminated materials began. As of January 1991, 149,592 tons (out of an estimated 287,060 tons) had been disposed of at a commercial facility.

Type of Impact/Media Affected: The maximum level of radium found in the contaminated soil was 5,093 pCi/g. Soil from six properties also exhibited Extraction Procedure (EP) toxicity for metals, total levels of polynuclear aromatic hydrocarbons (PAHs), and total levels of volatile organic compounds (VOCs). Other contaminants of concern included radium and radon.

Regulatory Actions/Environmental Claims: The site was placed on the NPL in 1983. Initial remedial investigations were initiated in 1981, and completed in 1982. The final Remedial Investigation/Feasibility Study (RI/FS) was completed in 1985. Seven Records of Decision (RODs) for 10 of the 11 Operable Units were signed in 1986 and in 1987.

References: U.S. EPA. Draft Final. *Mining Sites on the National Priorities List: NPL Site Summary Reports, Volume II.* June 21, 1991.

Idarado Mine: Millsite Areas Used for Hazardous Waste Disposal

Sector: Copper, gold, lead, silver, and zinc.

Facility: Idarado Mine, San Miguel, Ouray, and San Juan Counties, CO

Facility Overview: From 1956 until Idarado's mining operations were closed in 1978, all ore was transported through the Treasury and Mill Level Tunnels and milled near Telluride at the Pandora Mill. Zinc, copper, lead, silver, and gold were produced. In 1978, depressed metal prices necessitated cessation of Idarado's operations.

Waste Stream(s): Tailings, mine drainage, fire-assay slag, cupels, waste rock, and various chemicals.

Waste Management Practices: The site has three distinct natural areas: the Telluride Valley, where the Pandora Mill was located; the Red Mountain Mine; and the High Country between the two. The Telluride Valley contained four infiltration lagoons, four consecutive unlined tailings piles, and one combined, unlined tailings pile. This combined pile was sprinkled with water as a part of Idarado's dust control program. The tailings piles contained deposits of ground mine rock that remained after most of the valuable metals had been removed by milling. The lower end of the Telluride Valley, in an area known as Society Turn, encompassed more tailings piles. The Red Mountain Valley portion of the mine contained four tailings piles adjacent to Red Mountain Creek. The Red Mountain Valley also included buried tailings, the "Treasury Tunnel" mine portal, several other scattered mines, tailings piles, mine waste rock piles, and portals. The High Country consisted of scattered waste rock piles, portals and relics of past mining activities by prior owners or occupants.

Eight waste sources in both millsite areas were designated in 1985 after PCB contaminated soils were found. Wastes such as fire-assay slag, cupels, and barrels of various chemicals were excavated and shipped off-site. Tailings material was also disposed of at both sites, and used as fill in the Town of Telluride on properties and as ditch linings when sewer and water lines were laid.

Type of Impact/Media Affected: Precipitation flowed across and through the tailings piles, causing erosion and deposition of metals in the area's ground water, rivers, and creeks. Water also flowed from mine portals and crossed waste piles, where it picked up metals and other hazardous materials on its downward course, ultimately carrying metals and other hazardous constituents into the area's streams and sediments. Concentrations of zinc, cadmium, and copper in the San Miguel River were relatively low upstream but increased downstream past the Pandora Mill site. The high zinc concentration and the other heavy metals in the surface water and sediments in the San Miguel River caused significant degradation of the water quality as a habitat for aquatic life. Plant life density in the San Miguel River also decreased substantially downstream from the Telluride tailings piles, and this too was attributed to the presence of heavy metals.

The Telluride tailings piles were also continually eroded by wind. Blowing tailings contaminated soils and surface water with cadmium, lead, zinc, and copper. Tailings were blown into the Town of Telluride, producing a whitish-gray dust cloud that deteriorated the air quality. In addition, testing on the combined tailings pile indicated EP toxicity.

The three Society Turn tailings piles were situated in the San Miguel River. Sediments in the stream were contaminated with cadmium, lead, silver, and zinc, affecting the aquatic life in the area.

The Red Mountain tailings contaminated Red Mountain Creek with lead, cadmium, copper, silver, and zinc like the Telluride tailings contaminated the San Miguel River. In addition, non-point metals loading contributed to contamination of Red Mountain Creek, particularly near the buried tailings pile. No fish were found in the Creek, and plant life density was significantly reduced.

Discharge from mine portals and waste rock piles also contributed to the poor water quality of the streams in the Telluride and Red Mountain sides of the mine.

Regulatory Actions/Environmental Claims: In 1984, the State of Colorado began a Remedial Investigation and Feasibility Study, followed by a Preliminary Record of Decision, and finally a Record of Decision issued by the Colorado Department of Health. The United States District Court found that the Idarado Mining Company was required to implement a remediation plan that included stabilizing and capping the Telluride and Red Mountain tailings piles, moving and consolidating the Society Turn tailings piles, implementing a lead screening study in the community, plugging and diverting water from the mine portals, and remediating the millsites.

References: 707 F. Supp. 1227. *State of Colorado v. Idarado Mining Company, et al., No. 83-C-2385.* United States District Court, D., CO. February 22, 1989.

Lincoln Park Site: Ground Water Injurious to Cattle

Sectors: Uranium, thorium, vanadium, molybdenum

Facility: Lincoln Park Site, Cotter Corporation, Fremont County, CO

Facility Overview: The facility processed uranium ore into yellow cake from 1958 until 1986, when operations ceased. Alkali mining was conducted until 1979, when the acid milling process began.

Waste Stream(s): Tailings, uranium ore stackpile, raffinate, and spent sulfuric acid stockpiles.

Waste Management Practices: In 1971, a Soil Conservation Service (SCS) flood control dam was built in Sand Creek, about 4,000 feet north of the main tailings impoundment, to mitigate the effects of storm-generated floods. Prior to the dam's construction, storm water run-off from the Mill site flowed down Sand Creek to Lincoln Park and eventually into the Arkansas River. This run-off and contaminated ground water from springs and seeps in the Sand Creek channel were impounded and isolated from Lincoln Park and the Arkansas River. Cotter Corporation withdrew contaminated, impounded water and pumped it to the primary, lined impoundment. As part of the 1988 State cleanup mentioned below, a cut-off barrier was established at the site of the dam to prevent ground water flow beneath the dam.

During the milling process, molybdenum and vanadium were recovered as by-products during uranium concentrate production. During the period of alkali milling (prior to 1979), 10 ponds were used for storage of process liquid and fresh water, disposal of tailings, and storage of fresh water. Seven of the 10 ponds were unlined. In 1979, when the acid milling process began, a double-lined impoundment was installed with drains above the synthetic membrane and below the clay layer and synthetic membrane. Tailings from this acid leach process and water collected from ground water interceptors were stored in this impoundment. It consisted of two units: (1) a primary impoundment storing acid leach mill wastes, and (2) a secondary impoundment. Between April 1981 and August 1983, the contents of six of the ponds (2.2 million cubic yards of tailings) were moved to a double-lined secondary impoundment. Two other ponds were moved in 1978 during construction of the secondary impoundment.

The Mill occasionally processed custom ores such as waste raffinate from other mills and precipitates or slags from other processes. In one instance, PCB-contaminated ore was processed, which contaminated some of the plant areas. Trichloroethylene was used to extract the PCBs from the contaminated soils. In addition, a catalyst plant on the Mill site was operated briefly in 1978 and 1979 to recover metal values from spent catalyst material. The spent sulfuric acid was stockpiled on-site.

Type of Impact/Media Affected: Sources of contamination included the uranium ore stockpile, leakage from the old tailings areas, and the soils and rocks beneath the old tailings ponds. Contaminated ground water at the site flowed downgradient into the Lincoln Park area. Molybdenum concentrations were identified as being injurious to cattle and unsuitable for irrigating crops used for cattle feed. A contaminant plume of uranium and molybdenum extended from the site into the Arkansas River. Maximum concentrations of lead and selenium, as well as gross alpha and beta, exceeded maximum contaminant levels for drinking water.

Emissions of radionuclides and hazardous metals were measured through air and soil sampling. Wind transport of contaminants resulted in off-site soil concentrations of metals at or above a level of concern for agriculture use, cattle grazing, and wildlife. In particular, soil concentrations were above critical values for molybdenum, cobalt, nickel, arsenic, copper, zinc, and cadmium. In general, contamination decreased with distance from the site. Contaminated off-site soils were also entrained in surface flow, and contaminants were transported in the intermittent streams to the Arkansas River.

Off-site vegetation samples also have been contaminated at levels toxic to plants and/or animals.

Regulatory Actions/Environmental Claims: The Atomic Energy Commission (AEC) was the regulatory agency responsible for oversight of the facility from 1958 to 1968. Between 1959 and 1966, the AEC cited the site 18 times for failing to track radioactive releases. The Colorado Department of Health assumed regulatory oversight in 1968 and cited Cotter Corporation 82 times for various violations under the Nuclear Regulatory Commission regulatory process between 1968 and 1984. Among the state citations were exceedances of "As Low as Reasonably Achievable" particulate emissions, discharge and releases from tailings discharge pipes, and poor recordkeeping on control of off-site surface water contamination.

The State of Colorado conducted a Remedial Investigation in 1986 to determine the environmental characteristics and the type and extent of contamination. The site is listed on the NPL.

References: U.S. EPA. Draft Final. *Mining Sites on the National Priorities List: NPL Site Summary Reports. Volume III.* June 21, 1991.

Rubie Heap Leach: Releases of Cyanide from Heap Leaching at Gold Mine

Sector: Gold

Facility: Rubie Heap Leach, American Rare Minerals (ARM), Inc., Teller County, CO

Facility Overview: The Rubie site consisted of an open pit mine, cyanide heap leaching units, and associated facilities. The site had operated intermittently since 1980.

Waste Stream(s): Spent barren solution.

Waste Management Practices: Ponds at the site included a lined pregnant solution pond, a lined barren solution pond, a lined safety pond, and an unlined emergency overflow pond. A synthetic lined spillway connected the pregnant pond to the safety pond. Pregnant solution was conveyed from the heap to the pregnant pond in PVC-lined ditches, which were simply extensions of the lined pond. After percolating through the heap, solution was directed to the pregnant solution pond, then to carbon adsorption columns. Barren solution returned to the barren pond, where it was fortified with cyanide and caustics. Loaded carbon columns were removed to the stripping plant for ethylene glycol stripping.

Type of Impact/Media Affected: Several releases of cyanide solution had occurred, caused by leaks from the pregnant solution pond or tears in pond and ditch liners. Instances of overspraying of cyanide solution had occurred several times since 1985. Available information did not indicate the volume or chemical make-up of any discharges or leaks that may have occurred.

Regulatory Actions/Environmental Claims: During 1985 and 1986, four inspections by the Colorado Mined Land Reclamation Division (MLRD) noted problems such as overspraying, liner tears, and leaks at the site. Follow-up inspections noted that the problems were corrected. Subsequent MLRD inspections in 1988, 1991, and 1992 found tears and improper care of liners, permit boundary violations, ditch blockages, leaks, and dangerous pond levels. On August 3, 1988, the MLRD issued a Notice of Violation (NOV), a Cease and Desist Order, and a $2,500 civil penalty as well as a $30,700 fine if corrective actions were not taken. On November 15, 1988, the MLRD ordered ARM to provide additional financial warranty and informed ARM that they were delinquent in taking corrective actions. On April 25, 1991, the MLRD issued another NOV which cited ARM with failure to comply with the approved mine plan for the Rubie Site. ARM's request for reconsideration was granted by MLRD, which modified the Cease and Desist orders and allowed ARM to conduct operations provided that all corrective action orders were met.

References: U.S. EPA. Draft. *Mining Waste Releases and Environmental Effects Summary for the State of Colorado*. March 1994.

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Smeltertown: Bottled Water Needed to Replace Contaminated Well Water

Sectors: Lead, copper, silver, and gold

Facility: Smeltertown, CoZinCo, Salida, Chafee County, CO

Facility Overview: Activity began at Smeltertown in 1902 with the construction of a smelter and refinery for lead, gold, and silver. Operations continued until 1919. In 1920, the smelter was sold at auction to a timber company. The northern part of the site was used by several companies (e.g., Koppers which became Beazar East, Inc. in 1990) as a railroad tie-treating facility between 1924 and 1953. After that time, the property changed ownership a few times until purchased by Butala Construction which continues to operate a gravel quarry on the site. CoZinCo has operated a zinc sulfate manufacturing plant on-site since 1975.

Waste Stream(s): Miscellaneous smelting and refining wastes and treating wastes.

Waste Management Practices: Areas of contamination included several drum piles, sludge disposal and storage areas, and two wastewater lagoons. The smelting operation generated molten slag which was disposed of along the Arkansas River to the west of the smelter. Cinder material was also disposed of along the river directly south of the smelter. These features are still evident at the site. Ore storage areas were reportedly located north of the smelter facility.

During its use as a tie-treating facility, railroad ties and other lumber products were pressure treated with creosote, stored on railroad sidings near the treatment building, and allowed to drip. Effluent from the process area was directed to lagoons. More recently, surface soil was reportedly scraped from the site and buried in six trenches on the former Koppers property by Butala Construction. The trenches were approximately 100 feet long and 12 to 14 feet wide. This contaminated soil was reportedly in an area of red cinder off the former Koppers property and adjacent to the river.

Type of Impact/Media Affected: The smelting and wood treatment wastes have contaminated soils and ground water in the site and vicinity. Soils associated with smelter activities had elevated levels of arsenic, cadmium, copper, lead, manganese, and zinc. Surface soil metals concentrations were highest in the smelter part of the site, and decrease downwind of the smelter. Subsurface soil metals concentrations appeared to be related to very localized historic activities. The soils from both the smelter and Koppers wood-treatment area exceeded arsenic and lead remediation concentration levels. The affected soils covered approximately 3.0 acres at the smelter site and 7.8 acres at the Koppers site, for a total of 2,900 cubic yards. In addition, soil stockpiled on-site from various EPA emergency response cleanup actions was estimated at 40,500 cubic yards.

The wood treating contaminants included 16 creosote derived PAHs, possibly pentachlorophenol (penta), and multiple dioxin and furan isomers. Soils contaminated with these hazardous constituents were located at the process area, lagoons, and the area where Butala placed removed soil. Soil contamination extended from about 1 to 2 feet below ground surface to 40 feet below ground surface in some areas, thus impacting a regional alluvial aquifer.

Contaminated ground water extended from beneath the wood treating process area and continued off-site. Concentrations of PAHs in springs emanating from the site varied, generally with seasonal fluctuations in ground water levels. Contaminated ground water was detected extending off-site from the lagoons and in domestic wells in the area. Metals contamination also existed in ground water beneath the smelting area. Zinc concentrations exceeded the Superfund Removal Action level of 3.0 mg/L in the area south of the smelter and CoZinCo sites.

Regulatory Actions/Environmental Claims: The sources of contamination were addressed under a RCRA corrective action Order issued by the State of Colorado. In 1986, creosote contaminated soil was removed by Butala Construction from the former wood-treating portions of Smeltertown and disposed of at the Chaffee County Landfill. The EPA investigation of this occurrence led to the discovery of potential environmental impacts at the site. Subsequently, the site was proposed for NPL listing. The EPA issued letters to PRPs to initiate the process of further site investigation and removal action or remediation.

The EPA Emergency Response Team (ERT) conducted two site investigations to characterize contamination posing an immediate threat to human health and the environment. As a result of these investigations, soil was removed from off-site residential areas and stockpiled on-site. In addition, CoZinCo provided bottled water to residents downgradient of their facility.

References:
Draft Remedial Investigation Report Former Koppers Wood Treating Site, Salida, Colorado. ENSR Consulting and Engineering, October 1994.

Smelter Subsite Remedial Investigation Smeltertown Site Salida, Colorado. CH2M Hill, November 1994.

Feasibility Study Smeltertown Superfund Site. CH2M Hill, May 8, 1995.

Smuggler Mountain: Old Mine Listed on NPL

Sectors: Silver, lead, and zinc

Facility: Smuggler Mountain, Pitkin County, CO

Facility Overview: Silver, lead, and zinc were mined in the late 1800s and early 1900s. In the l960s, a reprocessing facility operated at the site.

Waste Stream(s): Waste rock, tailings, and slag.

Waste Management Practices: Smuggler Mountain contained mining wastes from years of extensive mining, milling, and smelting operations. The site contained 110 acres of waste rock, tailings, and slag. The bulk of the mining wastes were placed on the steep slope of the western side of Smuggler Mountain near the Smuggler shaft from 1880 to 1915. In the mid-1960s, the operation of the reprocessing facility caused the dispersion of the wastes from the relatively distinct piles at the mine shaft to other locations throughout the site. Also, a number of settling ponds were created around the site during reprocessing.

Mine wastes, such as waste rock, tailings, and slag, comprised much of the site. Approximately 2.4 million cubic yards of these waste materials were generated at the site; however, volume estimates were uncertain. The wastes had been spread over a wide area and at depths varying from 1 or 2 to 40 feet. The wastes were dispersed further by subsequent residential development. They occurred covered, uncovered, or mixed with native soil, and they contained high concentrations of lead and cadmium, among other constituents.

Type of Impact/Media Affected: Soil was the primary contaminated medium; however, contaminants had been found in ground water and surface water. Both mine tailings and man-made fill were contaminated with lead at concentrations greater than 1,000 mg/L. Significant amounts of cadmium had been detected in soil samples as well. Results of ground water sampling had shown high uranium, gross alpha, total dissolved solids (TDS), and trace metal concentrations. Residential and commercial development had occurred around the tailings areas, posing potential human health and environmental risks.

Regulatory Actions/Environmental Claims: The Smuggler Mountain site was added to the NPL in May 1986. The Operable Unit I Remedial Investigation/Feasibility Study (RI/FS) was completed in early 1986 and amended by EPA in the same year. Using the RI data, EPA prepared an Endangerment Assessment. The Superfund Enforcement Decision Document, signed on September 29, 1986, described the remedial actions to be taken at the site. Subsequent sampling in 1988 prompted EPA to change the selected remedy for Operable Unit 1 and postpone re-evaluating the remedy for Operable Unit 2 until a Remedial Investigation/Feasibility Study was completed.

References: U.S. EPA. Draft Final. *Mining Sites on the National Priorities List: NPL Site Summary Reports. Volume IV.* June 21, 1991.

Urad Mine and Mill: Tailings Contaminate Creek

Sector: Molybdenum

Facility: Urad Mine and Mill, Climax Molybdenum Company (CMC), Climax, CO

Facility Overview: The site was initially mined from 1914 to 1919. Mining and milling of molybdenum resumed from 1967 until 1974 when the ore body was exhausted. The mine had been inactive since then. CMC had revegetated roads and reservoir dam faces with fill from the upper and lower tailings areas. Tailing ponds and reservoirs overflowed seasonally.

Waste Stream(s): The inactive mine had three NPDES discharge points: Outfall 001, the discharge from the lower Urad reservoir; Outfall 002, the combined point discharge of all drainage from the upper tailings area; and Outfall 003, the combined point discharge of all drainage from the lower tailings area.

Waste Management Practices: Upon closure, waste rock from the Henderson mine, another CMC facility nearby, was used to reclaim the tailings areas, followed by application of sewage sludge and wood chips, and revegetation. Both the upper and lower tailings areas were equipped with drainage systems to direct infiltration to the creek. The systems were not connected and did not capture all of the drainage from the tailings areas. Discharge from the upper tailings area flowed to Ruby Creek and to the lower tailings area, where treated wastewater from the Henderson mine enters, and flows ultimately to West Fork Clear Creek.

Type of Impact/Media Affected: The discharge from the tailings areas and the mine portal, which were located in and near Woods Creek had caused the water quality standards in Woods Creek to be exceeded. Arsenic, cadmium, copper, iron, lead, manganese, silver, nickel, zinc, and hexavalent chromium had consistently been detected in the Henderson Mine discharge, which flowed into lower Urad reservoir, the tailings areas, underdrain discharges, and Outfall 001. Levels of manganese, zinc, and cadmium in Outfall 001 had exceeded applicable water quality standards. Several of these contaminants had been detected in Woods Creek below each of the tailings areas.

Regulatory Actions/Environmental Claims: The discharges mentioned above had caused state limits for many water quality parameters to be exceeded. As a result, the site was listed under Section 304(l) of the Clean Water Act (CWA) as significantly contributing to impairment of water quality in Woods and West Fork Clear Creeks. In response, the state issued Urad a permit that was intended to fulfill the requirements under Section 304(l). EPA, however, determined that the state permit did not satisfy these requirements and, therefore, disapproved the proposed permit in lieu of a federal permit. The federal NPDES permit issued for URAD in June 1991 served as the "individual control strategy" (ICS) to address the impacts on Woods and Clear Creek. The permit required that Urad meet final effluent limits based on applicable water quality standards and comply with all toxicity limits at Outfalls 002 and 003.

References: U.S. EPA. Draft. *Mining Waste Releases and Environmental Effects Summary for the State of Colorado*. March 1994.

Bartow Chemical Plant: Radioisotopes Contaminate Florida Ground Water

Sector: Phosphoric acid

Facility: Bartow Chemical Plant, Seminole Fertilizer Corporation (formerly W.R. Grace & Company), Bartow, Polk County, FL

Facility Overview: Production facilities of the site included phosphoric and sulfuric acid plants, ammoniated phosphate plants, a triple super phosphate plant, and a phosphate rock grinding facility.

Waste Stream(s): Phosphogypsum and process wastewater.

Waste Management Practices: The Bartow Chemical Plant is underlain with three aquifers. The depth of the surficial aquifer ranges from 10 to 60 feet. The intermediate aquifer ranges in depth from 59 to 200 feet. The typical depth at the facility to the uppermost useable aquifer (the Floridan) is approximately 200 feet.

Waste management facilities at Seminole included one wastewater treatment plant, nine surface impoundments, two landfills, and two phosphogypsum stacks. The wastewater treatment plant, which was a two-stage liming facility, was used only during unusually intense rainfall events. Two surface impoundments were associated with the wastewater treatment plant: Surface Impoundment No. 1 was the primary liming pond and Surface Impoundment No. 2 was the secondary pond. Surface Impoundment No. 3 occupies approximately 1.3 million square feet and was used as a cooling pond for process wastewaters, while Surface Impoundments Nos. 4-6 were a series of interconnected cooling ponds. The pH of the process water in the cooling ponds varied from 1.8 to 2.3, due to seasonal rains. Surface Impoundments Nos. 7-9 were old clay settling ponds. Of the facility's two landfills, only one was in use as of 1990. Landfill No. 1, occupying approximately 28 acres, was closed. Landfill No. 2 occupied 2 acres and was used for filter cloths and solid materials not pumped to the gypsum stack.

The north gypsum stack, which first received waste in 1954, occupied approximately 159 acres at an average height of 28 feet. This stack received process wastewater, phosphogypsum, gypsum solids from "tank clean out," and filter cloths. As of December 31, 1988, the north gypsum stack contained 14 million short tons of material. The south gypsum stack, which first received waste in 1965, occupied approximately 66 acres at an average height of 46 feet. As of December 31, 1988, the south gypsum stack had accumulated 42 million short tons of material.

Type of Impact/Media Affected: Activities at the Seminole Fertilizer Corporation facility had resulted in elevated levels of several parameters in ground water in the surficial and intermediate aquifers. This contamination had affected potable water wells in the area, some of which had been replaced with water from the City of Bartow's public supply.

Seminole maintained eight monitoring wells as part of the ground water monitoring system required for its state permit. Seminole had stated that MW-3 and MW-7 were upgradient, background wells. All other wells were listed as downgradient. The facility's ground water data from September 1986 through March 1989 showed that the downgradient wells repeatedly exceeded the water quality standards for pH, gross alpha radiation, radium-226, radium-228, iron, manganese, TDS, sulfate, cadmium, chromium, lead, and fluoride.

Regulatory Actions/Environmental Claims: On March 8, 1988, the Florida DER issued a warning notice to W.R. Grace & Company for violations of its ground water monitoring permit during the third and fourth quarters of 1987. The standards for gross alpha radiation, radium-226 and radium-228, and sodium had been exceeded in some ground water samples. The analytical results showed the following maximum concentrations for each parameter: gross alpha, 107 pCi/L; radium-226 and -228, 14.4 pCi/L; and, sodium, 657 mg/L.

In addition to on-site wells, neighboring potable water wells had also been adversely affected. Analytical data from May 1988 showed that 12 of 18 wells contained at least one contaminant at levels above the drinking water standards. Contaminants found in the samples included arsenic, lead, sodium, gross alpha, radium-226, radium-228, iron, pH, sulfate, and total dissolved solids. Potable water wells near the facility were replaced by a public water supply from the City of Bartow; W.R. Grace apparently paid for the water supply line installation and connection to the affected water users.

Seminole had also received a warning notice from the Florida DER in 1984 for an unpermitted discharge of process water from the facility to Bear Branch.

References: U.S. EPA. *Report to Congress on Special Wastes from Mineral Processing Facilities. Volume II: Methods and Analyses*. July 1990.

East Tampa Chemical Plant Complex: Acidic Discharge Kills Crabs

Sector: Phosphoric acid

Facility: East Tampa Chemical Plant Complex, Gardinier, Inc., East Tampa, Hillsborough County, FL

Facility Overview: Production and treatment facilities at the site included phosphoric and contact acid plants, a dry products manufacturing unit, wet rock mills, and a double lined treatment unit.

Waste Stream(s): Phosphogypsum and process wastewater.

Waste Management Practices: Gardinier, Inc.'s East Tampa Chemical Plant Complex encompassed about 2,600 acres located at the mouth of the Alafia River adjacent to Hillsborough Bay. The plant began operating in 1924 and had been expanded several times by various owners. In 1973, Gardinier, Inc. took over the entire operation. Operations included production of phosphoric acid and phosphate and other fertilizers.

Gardinier's on-site waste management units included two process water ponds (Nos. 1 and 2) and a gypsum stack. Process Water Pond No. 1 was an unlined pond that occupied 32 acres and was 6 feet deep; Process Pond No. 2 occupied 32 acres and was 8 feet deep. The gypsum stack, which as of December 31, 1988, contained about 76 million cubic yards of material, occupied an area of 61 acres and was 200 feet high. The ponds on top of the gypsum stack occupied 6.5 acres and were 7 feet deep. The typical pH of the liquid in the gypsum stack ponds was 1.8, which was highly acidic.

Phosphogypsum was piped to the gypsum stack as a slurry mixture with approximately 30 percent solids. The gypsum settled from the slurry and the liquid was decanted for reuse in the manufacturing process. Water that seeped through the stack was collected in a perimeter drain which was buried at the toe of the stack. The drain carried the seepage water to a sump in the northeast corner of the gypsum stack, where it was pumped to an evaporation pond located on part of the gypsum stack. Surface water run-off from the exterior slopes of the stack was discharged into Hillsborough Bay.

Type of Impact/Media Affected: Records at the Hillsborough County Environmental Protection Commission (HCEPC) cited environmental incidents at the Gardinier facility as far back as November 21, 1973, when HCEPC investigated a citizen's complaint and discovered 210 dead crabs in traps placed near the facility's northwest outfall. The pH of the outfall water was 2.9.

Regulatory Actions/Environmental Claims: Water quality violations attributable to Gardinier resulted in the following administrative actions as of 1989: (1) a Consent Order negotiated between the HCEPC and Gardinier on August 22, 1977; (2) a Citation to Cease Violation and Order to Correct from HCPEC on November 8, 1984; (3) a Warning Notice from the State of Florida Department of Environmental Regulation (FDER) on April 9, 1987; (4) a Citation to Cease and Notice to Correct Violation from the HCEPC on May 26, 1988; and (5) a Warning Notice from FDER on October 18, 1988. These administrative actions were issued to Gardinier following unpermitted discharges from either the gypsum stack or the cooling water ponds.

HCEPC issued the November 8, 1984, citation for an untreated effluent discharge which occurred on October 8, 1984. The citation noted that "toe-drain effluent contains several thousand mg/L of fluorides and phosphorus and up to 150 pCi/L of radioactive substances. Also, its pH can be as low as 1.5 standard units." A sample of the discharge on March 30, 1987, which resulted in the April 9, 1987, warning notice, showed that the pH was 1.9, total phosphorus was 6,740 mg/L, and dissolved fluorides was 4,375 mg/L. HCEPC subsequently analyzed another sample of the discharge which resulted in the October 18, 1988, warning notice and reported the following results: pH, 2.2; total phosphorus, greater than 4,418 mg/L; and fluoride, 1,690 mg/L.

The May 26, 1988, citation from HCEPC states that "available agency records indicate a considerable history of incidents of discharge resulting in exceedances of environmental standards and contamination of the air and waters of Hillsborough County. Enforcement in each case required remedial actions intended to correct the effects of the discharge where appropriate, as well as design and maintenance measures to prevent reoccurrence of the same or like incident. Despite all efforts, such incidents continue to occur."

HCEPC records also included a Gardinier Air Complaints Summary which lists 78 citizen complaints about the facility from December 6, 1983, to May 10, 1988. The complaints were made about noxious odors, fumes, smoke, dust or mist from the facility. One of the complaints clearly identified the gypsum stack as the source; the relationship of the other complaints to gypsum and water management systems at the facility could not be determined from the available documentation. HCEPC responded to most of these complaints with a phone call or site visit. At least three of the site visits resulted in HCEPC issuing a warning notice to the facility.

Since 1985, Gardinier had monitored ambient air quality for radon and fluoride. In 1985, Gardinier reported its average radon-222 flux from the gypsum pile to be 21.6 pCi/m^2-sec. (The NESHAP specifies a limit of 20 pCi/m^2-sec). Ambient fluoride was 0.43 µg/L, with a maximum reading of 1.2 µg/L. Gardinier reported that no National Ambient Air Quality Standards or National Emissions Standards for Hazardous Air Pollutants were exceeded during 1988.

In addition to the impacts to surface water, biota, and air noted above, the facility operations had contaminated ground water. Ground water quality had been monitored quarterly at the facility for several years. Since January 1, 1984, standards for the following drinking water parameters were exceeded in wells located both upgradient and downgradient of the facility's special waste management units: chromium, radium-226 and radium-228, gross alpha, chloride, iron, manganese, pH, and total dissolved solids. Examination of data for the period 1987 through early 1989 indicated that several on-site wells in the shallow aquifer routinely exceeded the gross alpha primary drinking water standard by a factor of between 2 and 4; exceedances in the intermediate aquifer were also common, although less frequent and of lesser magnitude.

References: U.S. EPA. *Report to Congress on Special Wastes from Mineral Processing Facilities. Volume II: Methods and Analyses*. July 1990.

Plant City Chemical Complex: Ground Water Contaminated at CPI Plant

Sector: Phosphoric acid

Facility: Plant City Chemical Complex, Central Phosphates, Inc. (CPI), Plant City, Hillsborough County, FL

Facility Overview: The production facilities at the CPI complex included two phosphoric acid plants, four sulfuric acid plants, a uranium extraction plant, one wet rock grinding unit, four granulation plants, and two storage and shipping units.

Waste Stream(s): Process wastewater and phosphogypsum.

Waste Management Practices: The Central Phosphates, Inc. (CPI) Plant City Chemical Complex occupied approximately 1,520 acres of land. The site is underlain by a surficial aquifer and the Floridan aquifer. The surficial aquifer ranges in depth from 1 to 50 feet and was recharged by local rainfall. In the Floridan aquifer, the uppermost useable aquifer at the site, wells were generally cased to depths greater than 200 feet. The principal uses of the water in the uppermost useable aquifers underlying the site were rural domestic, agricultural, and commercial/industrial.

The CPI plant began producing phosphate fertilizer, sulfuric acid, ammonia, and other products in 1965. Phosphogypsum generated during the production of phosphoric acid was disposed on-site at a 410-acre phosphogypsum stack. A 20 acre unlined process water cooling pond completely surrounded the gypsum stack. The cooling pond was 8 feet deep. As of December 31, 1988, the unlined gypsum stack was 111 feet high and contained approximately 70 million tons of material. The top of the gypsum stack contained eight ponding areas occupying a total area of approximately 43 acres. Two designated areas on top of the stack, located in the middle, were used for disposal of non-hazardous waste materials, such as construction and demolition debris and non-hazardous chemicals.

Type of Impact/Media Affected: Activities at the Central Phosphates site had contaminated the surficial and upper Floridan aquifers. The surficial aquifer and, to an undetermined extent, the Floridan aquifer had increased levels of fluoride, sodium, gross alpha radiation, heavy metals, sulfate, total dissolved solids, and nutrient compounds in excess of applicable guidance concentrations and/or state and federal drinking water standards. Contaminated ground water, primarily in the surficial aquifer, had migrated off-site under approximately 27.5 acres of the Cone Ranch property, located south of the CPI facility, as of 1989.

Regulatory Actions/Environmental Claims: Quarterly ground water sampling began at the Central Phosphates facility in April 1985. Based on the results of sampling from these wells in the second quarter of 1985, the Florida Department of Environmental Regulation (DER) issued a warning notice to the facility for violating the primary drinking water regulations. Maximum contamination levels for sodium and chromium were exceeded in a downgradient well in the Floridan aquifer and for sodium, chromium, and fluoride in a downgradient well in the surficial aquifer.

The final report on ground water investigations conducted at Cone Ranch during May and June 1987 identified two areas of contamination on the Cone Ranch property:

- Contamination in one area (designated Area A) was caused by a dike failure and resultant spill of process water from the Central Phosphates facility in 1969; and

- Contamination in another area (Area B) was caused by seepage of contaminated water from the recirculation pond located immediately north of the spill area.

DER and Central Phosphates, Inc. signed a Consent Order addressing the ground water contamination problems at the site on September 29, 1987. The Consent Order documented violations of primary and secondary drinking water standards for chromium, sodium, fluoride, gross alpha radiation, lead, and cadmium from a downgradient well in the surficial aquifer. These violations occurred from May 6, 1985, through April 27, 1987; maximum values listed in the consent order for each contaminant were as follows: chromium, 0.075 mg/L; sodium, 1,700 mg/L; fluoride, 6 mg/L; gross alpha, 29 pCi/L; lead, 0.11 mg/L; and, cadmium, 0.022 mg/L. The Consent Order required CPI to implement corrective measures and ground water remediation at the site.

The Joint Water Quality/RCRA Overview Committee of the Florida Phosphate Council had recorded quarterly sampling data from CPI from April 24, 1985, through January 18, 1989, for DER Well Nos. 1 through 6, as well as data from sampling in April 1988 for miscellaneous other wells located both on and off CPI property. These data showed consistent exceedances of water quality standards in the downgradient surficial aquifer for pH, iron, fluoride, manganese, total dissolved solids, and sulfate. Water quality standards for iron and total dissolved solids were consistently exceeded in the downgradient upper Floridan aquifer.

The Contamination Assessment Report for the CPI facility, prepared pursuant to the Consent Order, concurred with the assessment made by the West Coast Regional Water Quality Authority in its definition of two plumes of contaminated ground water which had migrated off-site. Area A was found to comprise an area of 15.5 acres in the surficial aquifer and 1 acre in the upper Floridan aquifer. The off-site areal plume within the surficial aquifer was found to extend approximately 500 feet south and 1,500 feet east of the CPI property. The plume in the surficial aquifer of Area B was found to extend approximately 490 feet south in the Cone Ranch property, covering an area of approximately 2 acres.

References: U.S. EPA. *Report to Congress on Special Wastes from Mineral Processing Facilities. Volume II: Methods and Analyses*. July 1990.

Blackbird Mine:
Endangered Salmon Potentially Affected by Poor Water Quality

Sector: Copper

Facility: Blackbird Mine, Noranda Mining Company, Lemhi, ID

Facility Overview: Since the late 1800's, various companies have mined for cobalt and copper by shaft and open pit methods. The current owner, Noranda Mining Company, has not operated the mine since 1982.

Waste Stream(s): Waste piles.

Waste Management Practices: Mining tunnels and waste rock piles were scattered along eight miles of Meadow and Blackbird Creeks. The piles and the open pit mine were located at the headwaters of Bucktail Creek. Some waste piles were as large as two million cubic yards.

Type of Impact/Media Affected: Acid drainage from the tunnels and leaching from waste piles contributed to poor quality streams in the area. Many investigations have documented the poor water quality and negative impacts on aquatic life of creeks downstream of the mine. Recent sampling documented high levels of arsenic, copper, cobalt, and nickel in downstream surface water and sediments. Copper levels exceeded EPA's Fresh Water Ambient Water Quality Criteria. The Snake River Sockeye Salmon, designated by the U.S. Fish and Wildlife Service as an endangered species, and the Snake River Spring/Summer Chinook Salmon, designated as a threatened species have been potentially affected by poor water quality.

Regulatory Actions/Environmental Claims: The site was added to the NPL in 1993.

References: U.S. EPA. Draft. *Mining Sites on the NPL.* August 1995.

Bunker Hill: One of the Largest and Most Complex NPL Sites

Sectors: Cadmium, lead, silver, zinc, phosphate, and sulfuric acid

Facility: Bunker Hill Mining and Metallurgical Complex, Gulf Resources, Kellogg, Shosone County, ID

Facility Overview: Mining began in 1889; smelting started in 1917. The facility includes the Bunker Hill mine, a mill and concentrator, a lead smelter, an electrolytic zinc plant, a phosphoric acid and fertilizer plant, a cadmium plant, sulfuric acid plants, and a central treatment plant. Plant operation ceased around 1980.

Waste Stream(s): Slag and tailings.

Waste Management Practices: Initially, all liquid and solid residues from mining and milling operations were discharged into the South Fork River and its tributaries. The river flooded periodically and deposited mining waste material or tailings onto the valley floor.

In the 1920s, waste management consisted of discharging mill tailings to a small impoundment, and placing lead smelter slag in a pile. Later, after reprocessing the tailings in the first impoundment, the resulting tailings were deposited in the Central Impoundment Area (CIA). After 1961, the coarse fraction of mill tailings served as sand backfill in the Bunker Hill Mine. The CIA also received mine drainage beginning in 1965, gypsum from the phosphoric acid and fertilizer plant after 1970, and wastes from the zinc plant and smelter after 1974. Decant from the CIA flowed directly into the river until 1974, after which time the decant from the gypsum discharge was returned to the phosphate plant.

Type of Impact/Media Affected: The Bunker Hill Superfund Site has been one of the largest and most complex Superfund sites in the nation. The site is three miles wide and seven miles long. Contaminants of concern have included antimony, arsenic, beryllium, cadmium, cobalt, copper, mercury, selenium, silver, zinc, asbestos, and polychlorinated biphenyls.

The upper 10 to 20 feet of soils on the valley floor have been combined with mine and mill tailings and rock dust generated in the early part of the century. Early milling practices resulted in the deposition of metals-rich tailings to low-lying areas. The South Fork of the Coeur d'Alene River received mine and mill waste for approximately 90 years. Surface water contaminant sources have included direct discharge of acid mine drainage, direct discharge of lead smelter and zinc plant wastes, seepage from impoundments, numerous accidental spills, and overland flow contaminated by heavy metals. Primary sources of ground water contamination have included seepage from the CIA, infiltration and ground water flow through valley-wide deposits of tailings, and ground water inflow upgradient of the site.

In 1986, EPA removed contaminated soils from 16 parks, playgrounds, and road shoulders. In 1989 and 1990, contaminated soil was removed from residential yards; yards chosen for the program had lead levels of greater than 1,000 ppm and were residences of small children or expectant mothers.

Regulatory Actions/Environmental Claims: In 1968, the construction of tailings ponds was mandated, and in 1974, wastewater treatment of outflow from tailings ponds was required. Bunker Hill was listed on the NPL in September 1983. Through a health intervention program, EPA has recommended against eating locally grown vegetables due to their possible contamination. In 1989, an inspection of the smelter complex conducted by the Agency for Toxic Substance and Disease Registry (ATSDR) resulted in a Public Health Advisory that concluded that the smelter complex was a significant risk due to acute exposure to arsenic from the copper flue dust piles, acute exposure to lead, cadmium, arsenic, and asbestos, chronic exposure to lead, cadmium, arsenic, and asbestos during site operations such as salvaging, and physical hazards. ATSDR recommended that site access be restricted.

References:

U.S. EPA. Draft Final. *Mining Sites on the National Priorities List: NPL Site Summary Reports. Volume I*. June 21, 1991.

Ceto, Nick (EPA Region 10). Written Correspondence Concerning Bunker Hill to Bruce Rappaport, ICF Incorporated. December 4, 1995.

Lucky Friday Mine: Tailings Discharge Kills Fish and Aquatic Insects

Sectors: Gold, silver, lead, and zinc

Facility: Lucky Friday Mine, Hecla Mining Company, Mullan, ID

Facility Overview: The Lucky Friday Mine and Mill had been in continuous operation since June of 1987. The site consisted of a 1,000 standard-ton-per-day flotation mill operating on-site and an underground mine.

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aste Stream(s): Mill tailings.

Waste Management Practices: Tailings solution was piped to tailings ponds. Hecla was permitted to discharge this solution to the Coeur D'Alene River under certain conditions.

Type of Impact/Media Affected: A January 28, 1988, release caused tailings to be released to the South Fork of the Coeur D'Alene River. Water samples taken 0.4 miles downstream detected 628 mg/L of total suspended solids. Another rupture released tailings to the South Fork. In September 1988, 100 gallons of copper sulfate were accidentally dumped into the South Fork, causing fish and aquatic insect kills. The Idaho Department of Environmental Protection (IDEP) estimated that it would be at least seven years before the fishery regained its pre-spill population.

Regulatory Actions/Environmental Claims: IDEP filed an NOV on May 15, 1990, for the September 6, 1988, copper sulfate spill. The NOV cited violations for failing to contain hazardous material, not ensuring that every effort was made to prevent the spill, and failure to notify the state immediately after the spill occurred. The violations carried fines of up to $10,000 per violation and $1,000 per day per continuing violation. Hecla was required to arrange a compliance meeting with IDEP in which they outlined the steps taken to correct the circumstances that resulted in the copper sulfate spill.

References: U.S. EPA. Draft. *Mining Waste Releases and Environmental Effects Summary for the State of Idaho*. March 1994.

Microgold II Mine:
Mercury Contamination from Gold Mining

Sector: Gold

Facility: Microgold II Mine, Powell Mining and Micro Gold II Partnership, Florence, ID

Facility Overview: The Microgold II Mine was composed of three claims on unpatented land in the Nez Perce National Forest. Mining operations occurred only during the summer of 1983. Ore was crushed and passed over a series of shaker tables. Mercury was then added to form an amalgam, which was heated. Gold was recovered, and mercury was recondensed from vapor.

Waste Stream(s): Tailings.

Waste Management Practices: Tailings from shaker tables were discharged to an unlined tailings pond.

Type of Impact/Media Affected: Releases of mercury contaminated the soils in the immediate vicinity of the processing area and around the shaker table mixing area. Approximately 12 pounds of mercury were released to soils in the shaker table area, contaminating approximately 20,000 square feet of soil. The tailings pond was contaminated with mercury by the discharge of untreated tailings. It was not determined whether elevated levels of mercury detected in ground water were due to the tailings seepage or a naturally contaminated spring in the area.

Regulatory Actions/Environmental Claims: The Idaho Department of Health and Welfare (IDHW) issued an NOV to Micro Gold II on November 23, 1983, because of the mercury levels in the tailings pond. A Finding and Order, dated February 14, 1984, found that the Micro Gold facility had operated without federal or state permits to discharge water and had used unlined settling and tailings ponds that provided an unimpeded route for possible ground water contamination. The Idaho Board of Health and Welfare (IBHW) ordered the mine's operators, Powell Mining, to prevent mercury migration, and to conduct monitoring and sampling. An Administrative Complaint was filed on September 10, 1984, alleging that Powell Mining did not comply with the Order. In February 1985, IDHW issued an Administrative Order requiring Micro Gold to develop a site investigation and cleanup plan. Cleanup using on-site encapsulation began in the spring of 1986. Under a Stipulation, Agreement, and Consent Decree issued on August 29, 1986, Powell placed money into an escrow account to pay for the remediation. This action absolved Powell of any further liability related to the mercury contamination.

References: U.S. EPA. Draft. *Mining Waste Releases and Environmental Effects Summary for the State of Idaho*. March 1994.

Nu-West Plant: Wastewater Spill Flows Four Miles

Sector: Phosphoric acid

Facility: Nu-West Plant, Nu-West Industries-Conda, Soda Springs, ID

Facility Overview: The Nu-West site was a large, complex facility that included processing equipment acquired over approximately 10 years.

Waste Stream(s): Phosphogypsum and process wastewater.

Waste Management Practices: The Nu-West plant covered approximately 1,600 acres. With the exception of a period from 1985 to 1987, the plant had been in operation since 1964. Nu-West formulates and markets phosphate-based chemicals and fertilizers. The phosphogypsum waste was a by-product of the digester system, which produces ortho-phosphoric acid (P_2O_5) from phosphate ore. Gypsum was slurried with process water and pumped to two storage ponds on top of the gypsum stacks, which had been used since 1964 and covered approximately 600 to 700 acres as of 1990. The gypsum ponds were unlined; the stacks were about 150 feet above the natural ground surface. Drainage systems decanted slurry water from the top of the higher ponds into lower ponds.

Type of Impact/Media Affected: During March 1976, a dike surrounding the Nu-West cooling pond failed and released 400 acre feet of wastewater into the surrounding area. The water spread out and ponded on an estimated 50 to 100 acres of farm land. The water then migrated via a natural drainage path, forming a small river that extended four miles to the south. Wastewater reportedly infiltrated into local soil and underlying bedrock along its overland migration path, but never entered a natural surface water body.

While the Idaho Division of Environment determined that dilution during spring run-off reduced surface concentrations of contaminants to within acceptable limits, the Caribou County Health Department recorded significant increases in ground water concentrations of phosphate, cadmium, and fluoride immediately following the spill. Samples from a J.R. Simplot Company (Conda Operation) production well No. 10, located downgradient from the Nu-West facility, showed that before the spill occurred, ground water phosphate levels averaged 100 mg/L, and after the spill, rose to 1,458 mg/L. Levels of cadmium in the ground water averaged 0.01 mg/L before the spill and 0.239 mg/L after the spill, and levels of fluoride averaged 5 mg/L before, and 39 mg/L after, the spill.

Regulatory Actions/Environmental Claims: In 1987, EPA Region 10 conducted a file review and site inspection of Nu-West. This inspection included ground water sampling, aqueous and solid sampling from the waste ponds, and a geophysical survey. Six ground water samples were collected: two from on-site industrial production wells (MF well, P.W. No. 1); two from off-site industrial production wells (Simplot No. 11, Simplot No. 10); and two from domestic wells in the site area. Selenium exceeded federal Primary Drinking Water Standards in all of the production well samples. Manganese and sulfate exceeded Federal Secondary Drinking Water Standards in Simplot Well No. 10. Phosphate was detected at 8.2 mg/L in Simplot Well No. 10, a level approximately 30 times greater than that found in the MF well and 170 times greater than that found in the background well (Simplot Well No. 11). A total of 11 target compound list inorganic elements were detected in at least one of the domestic well samples; however, none of the sample concentrations exceeded Federal Primary or Secondary Drinking Water Standards.

The geophysical survey results indicated that there was no significant difference between the background and on-site values obtained from the survey. The EPA Site Inspection Report, however, stated that "Levels of TCL inorganic elements and anions detected in the ground water samples during the [EPA] site investigation were similar to those obtained by the Caribou County Health Department during non-spill event time periods. The levels, however, detected during the [EPA] site investigation should not be considered indicative of stable long-term ground water quality conditions at the site . . .. [Data showed] that significant increases in ground water contaminant concentrations have occurred as a result of a past spill at the Nu-West facility. Although survey results were inconclusive, the data suggest that some leakage from the cooling pond may be occurring presently. If leakage from the cooling pond increases as a result of pond aging or increased water circulation, a contaminant plume may develop and migrate to the south-southwest." Seven registered domestic wells within a three mile radius of the Nu-West site served an estimated 27 people. These wells ranged between 90 feet and 245 feet deep. Eleven registered industrial production wells existed on and near the Nu-West site, one of which provided drinking water for approximately 45 J.R. Simplot employees in Conda (Simplot #11).

References: U.S. EPA. *Report to Congress on Special Wastes from Mineral Processing Facilities. Volume II: Methods and Analyses*. July 1990.

Illinois Zinc Plant: Heavy Metals Released by Run-off and Leachate

Sector: Zinc

Facility: Zinc Corporation of America (ZCA), DePue, IL

Facility Overview: From 1905 until 1966, New Jersey Zinc operated a zinc smelter, sulfuric acid plant, phosphoric acid plant, and diammonium phosphate plant at this facility. In 1966, Mobil Chemical Company purchased all plants except the zinc smelter, which ZCA operated until 1971. In 1990, there were approximately 26 employees producing zinc dust from zinc scrap.

Waste Stream(s): Zinc slag.

Waste Management Practices: Zinc smelting wastes were deposited in one pile at the southern end of the site. The pile covered approximately 10 acres and ranged up to 50 feet high. In addition, several smaller piles on the site measured approximately 100 feet in length and 10 to 12 feet in height. These smaller piles may have contained zinc slag in addition to other materials.

Type of Impact/Media Affected: As early as 1967, the predecessor agency to the Illinois Environmental Protection Agency (EPA), the Illinois Sanitary Water Board, suspected rainfall run-off contamination from zinc slag piles located on New Jersey Zinc's property. The Illinois EPA monitored the surface run-off and leachate from the zinc slag pile from 1973 to 1986. These analyses consistently showed levels of zinc, cadmium, copper, manganese, and lead in excess of the maximum contaminant levels (MCLs) for drinking water. For example, from March 5, 1973, to March 26, 1986, run-off samples that exceeded the established MCLs for drinking water from the slag pile ranged from 39 - 4000 mg/L for zinc (MCL = 5.0 mg/L); 0.5 - 3.6 mg/L for lead (MCL = .05 mg/L); 2.32 - 780 mg/L for manganese (MCL = 0.05 mg/L); 1.38 - 137.5 for copper (MCL = 1.3); and, 0.58 - 19.3 mg/L for cadmium (MCL = 0.01 mg/L). Run-off control measures (e.g., capping) helped to reduce the levels of contaminant discharge. Surface water samples taken during April, May, and June of 1989, after remedial controls were implemented at the facility, showed the following range of concentration levels: zinc, 44.0 - 75.2 mg/L; lead, 0.05 - 0.06 mg/L; manganese, 1.8 - 3.83 mg/L; copper, 3.2 - 4.4 mg/L; and cadmium, 0.18 - .79 mg/L.

Regulatory Actions/Environmental Claims: Due to repeated problems in meeting effluent standards from this site, Zinc Corporation of America received a five-month discharge variance in April 1988, and a five-year extension to this variance in January 1989. Discharge monitoring reports submitted by the facility for the fourth quarter of 1989 indicated that few surface water contamination problems remained. Monitoring data on the quality of ground water beneath the slag piles were not available.

References: U.S. EPA. *Report to Congress on Special Wastes from Mineral Processing Facilities. Volume II: Methods and Analyses*. July 1990.

Tar Creek:
Mine Water Contaminates Drinking Water Source

Sectors: Lead and zinc

Facility: Tar Creek, Ottawa County, OK and Cherokee County, KS

Facility Overview: Lead and zinc were mined at the site from 1904 to the mid-1960's. After mining operations ceased, the mines were flooded by inflows of surface and ground water.

Waste Stream(s): Acid mine drainage.

Waste Management Practices: Large capacity pumps were used during active mining to control ground water inflow and flooding. When mining activities ceased in the mid-1960s, the pumps were removed from the mines. By 1979, the majority of the underground mines were completely flooded. Acid mine drainage began to discharge via abandoned or partially plugged mine shaft openings and boreholes.

Type of Impact/Media Affected: High concentrations of metals in the surface and ground water were caused by sulfur-bearing minerals in the mine workings. At locations both above and below the acid mine water discharge points, chronic water quality criteria for several heavy metals were exceeded. Heavy metal loadings increased downstream, while the pH decreased, resulting in severe stress to the aquatic community of Tar Creek. Studies found no fish and only a few benthic macroinvertebrates were surviving in Tar Creek. The Creek was used for recreational purposes, including swimming. Several communities in Ottawa County had experienced ground water quality problems related to the mines. The contamination had been attributed to mine water entering the wells as a result of inadequate casings.

Regulatory Actions/Environmental Claims: In 1979, the Oklahoma Water Resources Board and the U.S. Geological Survey first investigated the site. Tar Creek was added to the NPL list in October 1981. Remediation was completed in 1986, and EPA continued to monitor the site.

References: U.S. EPA. Draft Final. *Mining Sites on the National Priorities List: NPL Site Summary Reports. Volume IV*. June 21, 1991.

Allied-Signal Hydrofluoric Acid Plant: Untreated Wastewater Discharged to Mississippi

Sector: Hydrofluoric acid

Facility: Allied-Signal, Geismar, LA

Facility Overview: The facility produced hydrofluoric acid by combining fluorospar rock with sulfuric acid in a furnace.

Waste Stream(s): Fluorogypsum and process wastewater.

Waste Management Practices: Fluorogypsum generated from the production of hydrofluoric acid was slurried with process water as it was removed from the furnace. The resulting slurry was transferred through a conduit system to an impoundment on the top of a fluorogypsum stack. Seepage and run-off from the fluorogypsum stack was collected in clay-lined ditches and flowed into an impoundment referred to as the clearwell. Some water from the clearwell was recycled into various plant operations, while excess water was discharged as needed into the Mississippi River via a NPDES permitted outfall after passing through a wastewater treatment plant.

Within the time period from 1986 to 1987, in an effort to find a profitable use for the large quantities of gypsum waste accumulating at Allied Signal's facility, Louisiana Synthetic Aggregates, Inc. (LASYNAG) began marketing the gypsum as a road base material. The gypsum was reportedly processed by excavating and screening the material from the fluorogypsum stockpile located at the Allied-Signal hydrofluoric acid plant in Geismar, Louisiana. Once processed, the fluorogypsum was marketed and shipped as "Florolite."

To avoid excessive levels of water in the clearwell during periods of high rainfall, which could lead to catastrophic failure of the containing levee, Allied had occasionally bypassed the treatment facility and discharged the clearwell water directly into the Mississippi River. This situation was allowed by EPA and Louisiana Department of Environmental Quality (LADEQ) under proper emergency circumstances (e.g., prior notice, reasonable cause). Emergency discharges occurred in January 1983; and from August 1983 through October 1983. In April 1984, Allied notified EPA of its intention to again bypass the treatment facility when discharging its clearwell water if its level rose another 12 inches, to a depth of 30 feet.

Type of Impact/Media Affected: Discharges or spills of untreated wastewater had caused contamination on several occasions. In April 1978, Allied noted a seepage area northwest of the clearwell; subsequent sampling revealed a low pH and the presence of phosphate in the seepage. In July 1978, a gypsum line break reduced pH levels in a drainage ditch feeding into Bayou Breaux. Allied discovered another leak in October 1980 in the northeast corner of the clearwell. Consultants to Allied noted that contaminated water penetrating the clay surfacing was "resulting in vegetation kills which cannot be tolerated." In August 1981, a gypsum slurry transport line ruptured and a portion of the Bayou Breaux dropped in pH from around 7 to as low as 2.6.

One of the primary difficulties in managing the gypsum stack and clearwell areas was preventing their physical failure. Stack failures had occurred in the past. In May 1979, Allied's east gypsum stack failed, resulting in the overflow of low pH gypsum slurry water into a roadside ditch along Highway 30. An estimated 95 percent of the spilled water was recovered. In October 1980, consultants to Allied Chemical identified four interrelated clearwell and gypsum stack problems: (1) levee overtopping; (2) levee stability (high risk of stack failure); (3) levee crest subsidence; and (4) levee toe leak. In August 1983, another slide (failure) occurred on Allied's gypsum stack.

In 1987, LASYNAG had the milled fluorogypsum used as road constructions material analyzed by several laboratories. One laboratory reported that with a resistivity of 500 ohmscm and a pH of 5.2, the material was considered very corrosive for most iron and steel products. The laboratory also stated that the high sulfate content and the low pH would likely make the material corrosive to concrete as well.

Regulatory Actions/Environmental Claims: During 1987, after several rounds of requests and data submittals, Louisiana's Department of Transportation and LADEQ's Office of Solid and Hazardous Waste authorized the use of Florolite on various road shoulders, embankments, and base courses. At least some of these approved projects were completed, including road work at a mobile home park.

In July 1988, the City of New Orleans Department of Streets concluded that the material would be acidic and corrosive for iron, steel, and concrete products and deemed the use of Florolite as a road base material in the City inadvisable.

On June 7, 1989, LASYNAG began construction of a test embankment for the "U.S. Highway 90 relocation construction project" through a stretch of wetlands in southern Louisiana near Amelia. After three weeks, LADEQ responded to complaints of dying biota and found "extremely acidic pH and high conductivity in water adjacent to the roadbed." Construction was ceased immediately.

References:
U.S. EPA. *Report to Congress on Special Wastes from Mineral Processing Facilities. Volume II: Methods and Analyses*. July 1990.

U.S. EPA. *Report to Congress on Special Wastes from Mineral Processing. Technical Background Document: Damage Case Investigation*. July 1990.

Arcadian Phosphoric Acid Plant: Emergency Discharges of Wastewater Released to Mississippi

Sector: Phosphoric acid

Facility: Arcadian, Geismar, LA

Facility Overview: This facility, formerly owned by Allied Chemical, had been operational since 1967.

Waste Stream(s): Phosphogypsum and process wastewater.

Waste Management Practices: Approximately 150 residents lived within one mile of the facility, which was situated along the Mississippi River. There were private drinking water wells within a one-mile radius of the facility. The water table occurs at 80 feet below the land surface in the wet season, and 100 feet in the dry season. The Mississippi River receives the discharges from this facility.

The phosphogypsum waste was slurried to the stack with process wastewater, which drained into a retention pond referred to as "the clearwell." There were four clearwells of differing sizes at the site, one of which was described as active. Six phosphogypsum stacks occupied the site as well, one or two of which appear to be active.

The effluent guidelines prohibiting discharge of process pollutants from a wet phosphoric acid facility were rescinded for the plants on the lower Mississippi due to poor soil stability and excess precipitation. EPA Region 6 described the condition as follows: "The withdrawal of the guidelines allowed the creation of the concept of active and inactive impoundments. The inactive impoundment drainage may be discharged directly to the receiving stream without limits provided no further wastes were sent to the inactive system and the discharge meets water quality standards."

Type of Impact/Media Affected: Two major categories of contaminant releases had occurred at this facility: radioactivity releases to the ground water and clearwell discharges to surface water causing excessive phosphorus and fluoride loadings, as well as elevated pH. A third area of concern was fluoride fugitive emissions from the clearwell.

Arcadian had installed numerous monitoring wells throughout the gypsum stack and clearwell areas. Arcadian's ground water monitoring report for the second half of 1988 showed gross alpha radiation in well P4 at 95 ± 31 pCi/L and 60 ±14 pCi/L in well P10. The MCL for gross alpha radiation was 15 pCi/L. These releases were not extensively documented in the files reviewed for the 1990 *Report to Congress*; the documents reviewed did not discuss actions taken in response to the results presented.

High precipitation in this region had prompted Arcadian to perform emergency discharges of excess water from its clearwell. Arcadian had justified this action by stating that until the NPDES permit effluent limitations were modified, there were no other environmentally acceptable alternatives to the emergency bypass of the clearwell water. Excess water apparently may have caused failure of the gypsum stack or of the clearwell walls. During a discharge on February 27, 1987, Arcadian stated that the action was necessary "to prevent possible injury and severe property damage." Such a discharge occurred again beginning on March 10 of the same year. During these discharges, pH values ranged from 1.3 to 2.5; phosphorus concentrations from 3,688 mg/L to 7,960 mg/L; and fluorine concentrations from 6,188 to 14,649 mg/L.

Regulatory Actions/Environmental Claims: An EPA NPDES Violation Summary, based on discharge monitoring reports from March 1986 to December 1987, showed that Outfall 003 violated effluent limits each month from at least December 1985 until August 1987. Contaminant concentrations were similar to those listed above. No enforcement action was taken for any of these violations, apparently because of the absence of an enforceable permit.

On December 8, 1988, EPA Region 6 issued an Administrative Order to Arcadian regarding several violations, including the discharge on October 28 of that year of calcium sulfate run-off (Outfall 003) containing total phosphorus of 8,176 lbs/day, exceeding the permitted limit of 7,685 lbs/day.

References: U.S. EPA. *Report to Congress on Special Wastes from Mineral Processing Facilities. Volume II: Methods and Analyses*. July 1990.

Faustina Works Phosphoric Acid Facility: Low pH Water Released to St. James Bayou

Sector: Phosphoric acid

Facility: Agrico Chemical Company, Donaldsonville, LA

Facility Overview: AGRICO Chemical Company's Faustina Works phosphoric acid plant began operations in 1974. In 1990, approximately 68 residents inhabited land within one mile of the facility.

Waste Stream(s): Phosphogypsum and process wastewater.

Waste Management Practices: Gypsum waste was slurried with process wastewater to a stacking area, where the solids settled out, and the water drained into adjacent ponds or clearwells. These wastes had caused problems with elevated concentrations of phosphorus and fluoride and acid pH levels in surface and ground waters. Emergency discharges of untreated waters to surface water had occurred periodically throughout much of the 1980s; contamination of the ground water was reported in 1986. Receiving waters were the Mississippi River and the St. James Bayou.

Type of Impact/Media Affected: On April 15, 1983, a portion of Agrico's 62-foot gypsum stack failed structurally and released 60 million gallons of water from its 100-acre pond onto plant property. The spilled water was pumped to another gypsum holding stack. Concern over the potential failure of this stack, however, led Agrico to discharge the untreated water to the Mississippi River over a period of several weeks. These discharges exceeded permit limits. After the pond failure, water of pH 2 was found flowing in an on-site drainage ditch at approximately 20 gallons per minute into the St. James Bayou.

The large volume of released water had destroyed a dam that controlled flow from the drainage ditch into the St. James Canal. Agrico reinstalled the dam on April 22, 1983, and transferred the low pH water still in the dammed section of the ditch back to the gypsum pond system. Agrico checked the water in St. James Canal, concluding that it did not seem affected by the low pH water discharged to it as a consequence of the April 15, 1983, gypsum pond failure.

Due to heavy rainfall, Agrico had continued to periodically perform emergency discharges of untreated stormwater from the clearwell, as occurred in March and again in June 1987. In its letter of notification, Agrico stated that "additional rain could result in catastrophic levee failure leading to loss of life, personal injury, or severe property damage."

In March 1986, Agrico reported to LA DEQ that the water along the length of the north and east phosphogypsum perimeter ditches might have been "slightly impacted" by phosphate, sulfate, and fluoride.

In August 1986, Agrico submitted to LA DEQ a Hydrologic Assessment report for the facility. LA DEQ regarded the reported situation as requiring corrective action, stating that "Contamination of the shallow ground water, although by constituents which were not of great concern, poses a threat to drinking water."

Regulatory Actions/Environmental Claims: Even under non-emergency circumstances, Agrico had difficulty keeping in compliance with NPDES permit limitations. In April 1987, an investigator reported that discharges from Agrico's inactive gypsum impoundment (Outfall 002) permitted levels by up to 35-fold.

In August 1987, LA DEQ determined that Agrico could not comply with the Louisiana Water Discharge Permit System that had been effective since March 1987. LA DEQ issued an

Administrative Order to Agrico to allow the facility to temporarily discharge water from gypsum stacks until standards were met.

References: U.S. EPA. *Report to Congress on Special Wastes from Mineral Processing Facilities. Volume II: Methods and Analyses*. July 1990.

Ormet Aluminum Plant:
Red Mud Discharges Cause High pH in Canal

Sector: Alumina (bauxite)

Facility: Ormet Corporation, Burnside, LA

Facility Overview: An alumina processing facility which produced only about 1 percent of the total reported 1988 alumina production.

Waste Stream(s): Red muds.

Waste Management Practices: Ormet Corporation's aluminum plant was situated near the Mississippi River. The processing unit generating red muds had been operational since 1958. The facility contained four red mud lakes, referred to as Nos. 1, 2, 3, and 4. These impoundments had a combined surface area of 210 acres. Impoundments Nos. 1 and 2 had been inactive since 1984. Impoundment 4 was the most recently constructed pit.

Type of Impact/Media Affected: During heavy rainfall events when excess water had accumulated in closed red mud impoundments 1 and 2, Ormet had discharged to a tributary of the "Panama Canal" on an emergency basis. The Panama Canal flows from east to west along the northern boundary of the facility, through residential areas, and was a source of domestic water in some cases.

Discharge of excess waters had resulted in high pH levels in some cases. For example, excess water was discharged to the Panama Canal between May 23 and May 27, 1983. Due to improper operation of the neutralization station, combined with communications problems, high pH levels were not detected until after the discharge event. The excessive pH levels ranged from 9.4 to 10.2 for 4.5 hours on May 23, 1983, and from 9.7 to 9.8 for 7.5 hours on May 24, 1983.

Ormet had stated that "the Panama Canal cannot readily assimilate the discharge of excess rainwater from the Red Mud Impoundments" and that "flow in the Panama Canal stops on some occasions, and on others actually flows backward because of wind or tidal action." The Louisiana Department of Environmental Quality (LADEQ) raised concern over the impact of these discharges on the Panama Canal, and requested that Ormet look into the option of discharging to the Mississippi River. The emergency discharges to the Panama Canal had imparted a red color to the canal water, resulting in complaints from local residents. Investigation into this phenomenon led LADEQ to conclude that the problem was primarily aesthetic, and no formal action was taken. LADEQ, however, did contact Ormet about "ameliorating the conditions in the Panama Canal."

Regulatory Actions/Environmental Claims: In 1987, LADEQ's Ground Water Protection Division expressed concern that Ormet's proposal to close the red mud impoundments in their present condition would allow production of leachate and possible ground water contamination. LADEQ also suggested continued ground water monitoring as a part of closure. Ground water monitoring data were not found in the documents reviewed for the 1990 *Report to Congress*.

References: U.S. EPA. *Report to Congress on Special Wastes from Mineral Processing Facilities. Volume II: Methods and Analyses*. July 1990.

Torch Lake Copper Mines: Tailings Contaminate Fish and Create Public Health Concern

Sector: Copper

Facility: Torch Lake, Keweenaw Peninsula, Houghton County, MI

Facility Overview: From 1868 to 1916, copper ore was milled and processed around Torch Lake. From 1916 to 1968, copper recovery from previously discarded tailings in Torch Lake steadily increased using a flotation process that agitated ore, water, oil, and chemical reagents.

Waste Stream(s): Tailings and process wastewater.

Waste Management Practices: Beginning in the 1860s, mills crushed, ground, and drove copper through successively smaller meshes. Copper and crushed materials were separated by gravity in a liquid medium. After sending the recovered copper to a smelter, the tailings and process wastewaters were disposed of into or on the land surrounding Torch Lake. In 1916, copper recovery from previously discarded tailings began. The submerged tailings were collected, screened, recrushed, and gravity-separated at one of three reclamation plants. Initially, copper was recovered using an ammonia-leaching process. Later, the procedure consisted of a flotation process that agitated ore, water, oil, and chemical reagents, and created a froth that would support copper-bearing particles. After the process, the tailings were discharged into Torch Lake. The last mill closed in 1968. In the 1970s, copper recovery plants again began operating, but discharged only noncontact cooling water to Torch Lake.

Type of Impact/Media Affected: Between 1868 and 1968, Torch Lake received an estimated 200 million tons of tailings, reducing the Lake's volume by 20 percent and dramatically altering the shoreline. In 1989, the U.S. Bureau of Mines sampled mine-tailings leachate and water quality and concluded that leachate from Torch Lake mine tailings was extremely low in comparison to leachate from 30 other sites and that the tailings released very little metal. Studies, however, had found an increased incidence of lesions and tumors on Sauger and Walleye caught in Torch Lake.

Regulatory Actions/Environmental Claims: In 1983, the Michigan Department of Public Health issued a fish consumption advisory on all Sauger and Walleye caught in Torch Lake. Also in 1983, the International Joint Commission's Water Quality Board designated Torch Lake as a Great Lakes Area of Concern. In June 1988, EPA listed Torch Lake as an NPL site. In 1988, the Preliminary Health Assessment for Torch Lake conducted by the Agency for Toxic Substances and Disease Registry concluded that the site was a potential public health concern because of possible exposure to unknown etiological agents that may have created adverse health effects over time.

References: U.S. EPA. Draft Final. *Mining Sites on the National Priorities List: NPL Site Summary Reports. Volume V.* June 21, 1991.

Doe Run Lead Smelter: Slag Metals Found in Ground Water

Sector: Lead

Facility: Doe Run, Boss, MO

Facility Overview: Also known as AMAX Homestake Smelter, the facility produced a black semi-glassy, sand-sited slag during the reduction of lead sinter by coke. The facility began operating in 1968.

Waste Stream(s): Lead slag.

Waste Management Practices: The 250-acre site was located on a ridge separating the watersheds of the Left Fork of Neals Creek (to the south) from that of Crooked Creek (to the north.) This area had been identified as a recharge area for the underlying aquifer. There were private drinking water wells within a one-mile radius of the facility. The water table occurred at 145 feet below the land surface in both the wet and dry seasons. A perched water table also existed five feet below the land surface. Crooked Creek received wastewater discharges from smelting operations, while Strother Creek received discharges from the mine and mill. The mean annual precipitation was about 46 inches.

The slag disposal area consisted of a flat-topped "bench" along the eastern side of the head of a small valley that was underlain by clay-based residuum. The slag was piped as a slurry to the slag disposal area where it was dewatered, then trucked to the on-site sinter plant for reuse as sinter or to the slag disposal area for disposal. A total of about 480,000 tons of slag had been placed in the slag disposal area over nearly 20 years of primary smelter operation. The piled slag covered about 5 acres at its base with a thickness of 20 to 55 feet. The slag pile was generally unvegetated.

Type of Impact/Media Affected: Doe Run began a comprehensive investigation of the primary smelter slag disposal area in 1984. Soil boring analyses revealed that some residuum samples from beneath the slag contained elevated concentrations of lead, zinc, and cadmium. The exhibit below shows analyses of boring samples typical for uncontaminated residuum, contaminated residuum, and the slag itself. These data show that uncontaminated residuum might have contained up to 10 mg/kg lead. The slag itself may have contained 3,800 mg/kg, while the residuum contaminated from slag leachate may have contained 2,400 mg/kg lead. Similar comparisons could be made for zinc and cadmium, and possibly copper.

Metals Content of Slag and Residuum
Doe Run, Boss, Missouri

Sample	Media	Depth (ft.)	Concentration (mg/kg)			
			Pb	Zn	Cd	Cu
K1	Uncontaminated Residuum	16 - 16.5	5.4	16	0.11	37
K2	Uncontaminated Residuum	54 - 54.5	10	27	0.13	41
K9	Contaminated Residuum	43.5 - 44	2,400	390	7.3	160
K10	Contaminated Residuum	21 - 22	990	230	2.8	28
K9	Slag Pile	24 - 24.5	3,800	6,800	14	250

Monitoring well data from 1988 showed that cadmium, lead, and zinc concentrations in the ground water below the slag disposal area exceeded drinking water standards. These data showed that contamination of the ground water below the slag disposal area had occurred, though it was unclear if this contamination was attributable to the slag pile directly or to two adjacent impoundments that contained water from the slag storage area. Several independent laboratories analyzed subsamples of each sample to derive a mean value. Mean cadmium levels ranged up to 0.67 mg/L (67 times the MCL); lead ranged up to 0.6 mg/L (12 times the MCL); and one mean value for zinc contained 7.4 mg/L (1.5 times the MCL). Three wells had consistently elevated cadmium levels: the 11 samples from well K2 averaged 0.087 mg/L; the six samples from well K5A averaged 0.431 mg/L; and the six samples from well K8 averaged 0.021 mg/L. These wells were all located within 400 feet of the slag disposal area, and all appeared to be downgradient. Background monitoring well data were not located in the available documentation for the 1990 *Report to Congress*.

Regulatory Actions/Environmental Claims: In 1984, EPA Region 7 performed a Potential Hazardous Waste Site Preliminary Assessment. The inspector found that "surface impoundments and slag piles containing heavy metals could possibly contaminate ground and surface water." The inspector also listed blowing dust from the slag pile under "Hazardous Conditions and Incidents."

References: U.S. EPA. *Report to Congress on Special Wastes from Mineral Processing Facilities. Volume II: Methods and Analyses*. July 1990.

Glover Lead Smelter: Contamination in Ground and Surface Water

Sector: Lead

Facility: ASARCO, Glover, Iron County, MO

Facility Overview: This primary lead processing facility began operations in 1968. It is located within the Mark Twain National Forest in the Missouri Ozarks, in an area known as the "Old Lead Belt."

Waste Stream(s): Lead smelter slag.

Waste Management Practices: Slag generated by the smelter was stored in an on-site pile which was upslope and upgradient of the facility. Wastewater discharged under an NPDES permit, surface run-off and ground water flow from the facility towards or into Big Creek. Although in preparing the 1990 *Report to Congress*, EPA found no documentation directly stating that the lead slag piles were the source of heavy metals releases to surface or ground waters, some of the data reviewed suggest that the lead slag was at least part of the source.

Type of Impact/Media Affected: In May 1985, ASARCO conducted a hydrologic characterization of the Glover facility. Data from this study showed that, in contrast to background or upgradient samples, elevated cadmium, zinc, manganese, and possibly chromium concentrations were present in many surface and ground water samples collected downgradient of the lead slag pile. (See exhibits below.) Cadmium concentrations exceeded the MCL by a significant amount in bedrock wells (0.027 - 0.053 mg/L), shallow wells (0.52 - 2.3 mg/L), and surface waters (0.52 - 4.3 mg/L) downgradient of the slag. Manganese and zinc were also present in the shallow wells and surface water downgradient from the slag pile. Background values for the deep aquifer were not available.

In October 1985, the Missouri Department of Natural Resources (MODNR) stated, based on the data reviewed up to that time, that "[e]ither there was a very significant nonpoint source of cadmium or there were significant unreported discharges from ASARCO or there were both."

Regulatory Actions/Environmental Claims: In May 1987, EPA conducted a Potential Hazardous Waste Site Investigation and expressed concern that "surface water run-off from slag piles could be contaminating the streams surrounding the lead smelter with heavy metals." In 1988, under a Settlement Agreement with the MODNR, ASARCO constructed a collection and treatment system for stormwater run-off from the facility, including the slag area.

References: U.S. EPA. *Report to Congress on Special Wastes from Mineral Processing Facilities. Volume II: Methods and Analyses*. July 1990.

Summary of Exceedances from Well and Surface Water Analyses
ASARCO, Glover, Missouri

Station[a]	Total No. Samples[b]	Number of Samples Exceeding MCL/Maximum Exceedance Factor[c]						
		Cd	Fe	Mn	Pb	Zn	TDS	SO_4
Deep Aquifer								
Downgradient								
103D	3	2/5.3	0	0	2/1.4	0	3/4.04	3/4.52
Shallow Aquifer								
Upgradient								
101	6	0	0	0	1/1.4	0	0	0
102	6	0	0	0	0	0	0	0
Downgradient								
MW-4	6	6/230	1/2.1	5/2.4	3/2.4	2/1.86	6/4.01	6/4.76
103	3	3/4.5	0	0	0	0	3/1.88	3/1.82
104	6	6/57	6/6.8	6/9.9	1/1.6	0	5/2.29	3/2.41
105	6	0	0	4/2.3	1/1.6	0	0	0
MW-3	6	3/1.7	0	0	3/1.6	0	0	0
Surface Water								
Scroggins Branch								
300	5	0	0	0	0	0	0	0
301	6	1/1.2	0	0	1/1.6	0	0	0
Slag Seep								
303	6	6/430	0	1/1.26	6/5.6	5/7.14	6/2.65	6/3.28

(a) Bedrock Well = 103D (Depth to gw=12.3m; distance from slag pile<50m).
Shallow Wells = MW-4 (depth<2m; distance=100m); MW-3 (depth<3m; distance=100m); 104 (depth=1m; distance=100m); and 105 (depth=1.7m; distance<200m); Background (referenced by ASARCO) = 101 (depth=0.76m; distance=244m); and 102 (depth=1.2m; distance=732m).
Surface Water Station = 303 (Slag Pile Seep); Background - Scroggins Branch (referenced by ASARCO) = 300 (distance from slag pile=244m) and 301 (distance=152m).

(b) Samples collected between 8/84 and 3/86.

(c) First value was number of samples exceeding MCL. Second value is Maximum Exceedance Factor, which was derived by dividing highest concentration detected by the MCL (e.g., a concentration of 0.12 mg/L lead exceeds the MCL of 0.05 mg/L by a factor of 2.4).

Oronogo-Duenweg Mining Belt: Contaminants Spread Over Wide Area

Sectors: Lead and zinc

Facility: Oronogo-Duenweg Mining Belt, Jasper County, MO

Facility Overview: Mining began in the area around 1848 and continued until the late 1960's. As many as 4,000 shallow subsurface mines and some strip mines were worked in the area until 1970 when all commercial mining had ceased. The site is located in the tri-state mining district of Kansas, Missouri, and Oklahoma.

Waste Stream(s): Tailings, barren rock, and other process wastes.

Waste Management Practices: Tailings were skimmed from the jigging table and discarded in large piles. Waste products from processing were placed in large tailings piles. Barren rock containing no valuable minerals was also discarded in piles.

Type of Impact/Media Affected: Contaminants from the site spread over a wide area by surface water flow, ground water migration, and atmospheric dispersion. Contaminated media at the site have included ground water, surface water, sediment, surface soil, and certain components of the aquatic and terrestrial food chain. Contaminants of concern included cadmium, lead, and zinc.

Regulatory Actions/Environmental Claims: The U.S. Department of Health and Human Services and the Agency for Toxic Substances and Disease Registry (ATSDR) completed a Preliminary Health Assessment for the site. In addition, the State of Kansas conducted several health surveys that indicated a high incidence of tuberculosis and lung cancer among area residents.

References: U.S. EPA. Draft Final. *Mining Sites on the National Priorities List: NPL Site Summary Reports. Volume IV.* June 21, 1991.

Montana

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New Mexico

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North Carolina

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North Dakota

North Dakota

Northwest United States

Northwest United States

Ohio

Ohio

Oregon

Oregon

Oregon

Oregon

Pennsylvania

Pennsylvania

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Pennsylvania

Pennsylvania

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South Carolina

South Carolina

South Dakota

South Dakota

South Dakota

Anaconda Smelter: Pollution from Copper Processing Wastes Force a Community to Relocate

Sector: Copper

Facility: Anaconda Smelter, Mill Creek, MT

Facility Overview: The Anaconda Copper Mining Company began smelting operations in 1884. In 1977, the company merged with ARCO. From 1977 to 1980, ARCO operated the smelter. All structures were demolished in 1980, except the stack. The Anaconda smelter was one of four separate but contiguous Superfund sites located in the Clark Fork River Basin.

Waste Stream(s): Tailings, furnace slag, and flue dust.

Waste Management Practices: Ore processing wastes including about 185 million cubic yards of tailings, 27 million cubic yards of furnace slags, and 250,000 cubic yards of flue dust were contained within an area of more than 6,000 acres. These wastes contained elevated concentrations of copper, cadmium, arsenic, lead, and zinc. Tailings were usually deposited in ponds to allow solids to settle out before recycling or releasing the wastewater into nearby waterways. Tailings mounds up to 90 feet deep remained on-site.

Type of Impact/Media Affected: Soil sampling in the Mill Creek community showed much higher levels of arsenic and other heavy metal contaminants than other communities in the area. Arsenic was concentrated in the top six inches of soil. In the majority of soil profiles sampled, arsenic concentrations approached area background levels at a depth of 42 inches. May 1986 water samples indicated arsenic contamination in seven household water supplies. Urine samples from pre-school children living in Mill Creek, conducted by the Center for Disease Control in 1985, found greater arsenic exposure than in children from another community in the Anaconda area. Mean urinary arsenic levels of residents living in Mill Creek residents decreased after they were permanently relocated under the Superfund program.

Regulatory Actions/Environmental Claims: The Anaconda Smelter site was listed on the NPL in September 1983. In July 1986, EPA entered into an Administrative Consent Order with ARCO to conduct an expedited remedial investigation and feasibility study for Mill Creek. The Record of Decision, completed in 1987, mandated the permanent relocation of Mill Creek residents. This remedy was selected in part because the area had the potential to become recontaminated.

References: U.S. EPA. *Mining Sites on the National Priorities List: NPL Site Summary Reports, Volume I.* 1991.

Basin Creek Mine:
Gold Mine Contaminates Local Waters

Sector: Gold

Facility: Basin Creek Mine, Basin Creek Mining, Inc. (subsidiary of Pegasus Gold), Lewis and Clark and Jefferson Counties, MT

Facility Overview: Basin Creek Mine was an open pit gold mine that conducted cyanide heap leaching. Basin Creek Mining acquired the mine, formerly owned by Pangea Mining, in 1989.

Waste Stream(s): Spent leaching solution.

Waste Management Practices: Cyanide heap leaches had leaked three times. The first leak resulted from a valve that was left open causing an unspecified amount of cyanide to leak onto a leach pad dike. Cyanide solution flowed through a hole at the top of the liner resulting in the percolation of cyanide through the course fill under the leach pad. The second cyanide leak was caused by a Bobcat loader which tracked material from lined to unlined areas. Cyanide was also found in a sediment pond used to collect run-off drainage from process areas.

Type of Impact/Media Affected: A 1990 Environmental Assessment identified two streams with lower pH and higher sulfate, iron, manganese, and zinc concentrations than other streams in the area. These two streams occasionally exceeded EPA drinking water standards and aquatic life criteria. The cyanide leaks mentioned above had resulted in Basin Creek Mining removing contaminated surface soils to lined areas. Ground water monitoring had shown elevated fluoride levels downgradient of leach pad #3 near or above the federal Drinking Water Standards. Other wells downgradient of leach pad #1 and the general facilities area showed elevated manganese and iron levels that exceeded federal Drinking Water Standards. Water quality information from springs in the Monitor Creek drainage showed conditions typical of acid mine drainage (i.e., low pH and high metals). Two springs showed lead and cadmium levels exceeding federal Drinking Water Standards; one of these springs also contained low concentrations of cyanide.

Regulatory Actions/Environmental Claims: The Montana Department of State Lands issued a Notice of Noncompliance (No. 135) for cyanide contamination in a mud puddle near the agglomeration/pugmill area. No other regulatory actions were described in the available information.

References: U.S. EPA. Draft. *Mining Waste Releases and Environmental Effects Summary for the State of Montana*. March 1994.

Cable Creek Project: Spring Thaw Causes Overflow Pond Discharges

Sectors: Gold and other precious metals

Facility: Cable Creek Project, Cable Mountain Mine, Inc., Deer Lodge County, MT

Facility Overview: Cable Mountain Mine obtained gold ore by excavating gold-bearing sands and gravels in placer deposits within and adjacent to Cable Creek. Ore was washed, the gold concentrate was ground, and mercury mixed in. Gold was removed from the mixture using amalgam plates.

Waste Stream(s): Waste rock and mercury bearing solution.

Waste Management Practices: Overburden and coarse tails were stockpiled on-site and were backfilled into the mined-out pit. Tailings were treated to remove any mercury remaining in them before they were used as backfill. Fine tails were held in settling ponds ahead of the pit, and removed as overburden as the pit progressed. A sediment control basin had been constructed at the downgradient end of the mine site to remove sediment from the creek before it left the site.

Type of Impact/Media Affected: In the spring of 1989, the settling ponds rapidly filled as a result of the spring thaw. Cable Mountain Mine was forced to discharge from the sediment control pond directly to surface water by circumventing the final settling pond.

Regulatory Actions/Environmental Claims: As a result of the surface water release, the Montana Department of State Lands recommended in a Notice of Nonconformance that Cable Mountain Mine cease discharges, submit a plan for removal of deposited sediment, and submit a revised operating plan, in compliance with Montana's Water Quality Act, which addresses the spring thaw problem. On May 22, 1989, the Montana Department of State Lands issued a Notice of Noncompliance (NON) to Cable Mountain Mine for violation of the Montana Metal Mine Reclamation Act (MCA Sections 82-4-301): Unauthorized discharge from sediment pond (Notice of civil penalty related to NON 125). As part of this notice, on January 14, 1991, Cable Mountain Mine was assessed a civil penalty of $700 for the violation.

References: U.S. EPA. Draft. *Mining Waste Releases and Environmental Effects Summary for the State of Montana*. March 1994.

East Helena Smelter: Elevated Blood-Lead Levels Found Nearby

Sectors: Lead and zinc

Facility: East Helena Smelter, ASARCO, East Helena, Lewis and Clark County, MT

Facility Overview: The site included an active primary lead smelter with an adjacent paint pigment plant. Former practices at the site included recovery of lead bullion and zinc from the smelter's waste slag (1927-1982). The smelter began operations in 1888.

Waste Stream(s): Process wastewaters.

Waste Management Practices: Four major process fluid ponds had been used for (1) the collection and storage of water used in the main plant process circuit; (2) cooling hot speiss during speiss granulation processing; (3) recirculating into the scrubber and sinter plant; and (4) preliminary settling of suspended solids. Three ponds were still in operation. The fourth pond was previously used for preliminary settling of suspended solids from main plant operations. This unit contains no process fluids and was no longer in operation.

Type of Impact/Media Affected: Contamination from this plant had been measured over a 100-square mile area. The sources of contamination were primary and fugitive emissions and seepage from process ponds and process fluid circuitry. Blood tests in children residing in the adjacent community had shown levels twice the national average. The studies mentioned below found contaminated soils in residential areas and the Endangerment Assessment showed contamination in pond sediments, on-site soils, surface water, and ground water below the site and the town of East Helena. Seepage from one of the ponds into Prickly Pear Creek contributed to ongoing violations of state water quality standards, principally caused by mining leachate entering the creek upstream of the smelter. Constituents of primary environmental concern included arsenic, cadmium, copper, lead, and zinc. Arsenic was of the greatest concern due to its mobility and carcinogenicity.

Regulatory Actions/Environmental Claims: Numerous environmental investigations had been conducted at the site since 1969. The Montana State Air Quality Bureau (AQB) and the United State Geological Survey (USGS) had monitored and studied the site, and the Center for Disease Control (CDC) had tested blood-lead levels of residents. The site was added to the NPL in September 1983. Remedial Investigation/Feasibility Studies had been prepared for the four operable units at the site. The Endangerment Assessment prepared in support of the Feasibility Study for the process ponds identified a human health risk. In the process of negotiations between EPA and the PRPs, a consent decree was signed on June 30, 1990, in support of the Record of Decision (ROD) on the operable unit containing the process ponds.

References: U.S. EPA. Draft Final. *Mining Sites on the National Priorities List: NPL Site Summary Reports. Volume II*. June 21, 1991.

U.S. Antimony Mine:
Mine Tailings Contaminate Creek and Wildlife

Sector: Antimony

Facility: U.S. Antimony Corporation (USAC), Thompson Falls, Sanders County, MT

Facility Overview: From 1972 to 1983, the facility beneficiated antimony concentrates by leaching the ore in a solution of sodium hydrosulfide and caustic soda. From 1984 until 1987, plant operations were ceased due to environmental violations. In 1987, the plant reopened with a different beneficiation operation.

Waste Stream: Spent barren solution.

Waste Management Practices: Barren solution was regenerated and recycled before being discharged to one of three tailing ponds. Due to poor current efficiency in the electrowinning circuit, as well as precautions against the potential generation of stibine gas (a deadly poison), high solution concentrations (6,000 - 10,000 mg/L) of antimony were deposited in the flotation mill tailings ponds. The tailing ponds were located on U.S. Forest Service land under a Forest Service special use permit. While most of the antimony and arsenic were precipitated as stable sulfides, soluble antimony concentrations of 10 - 150 mg/L remained in the tailings. The facility closed in 1984 and reopened in 1987 under a NPDES permit, which stipulated a new method for processing antimony and handling process wastes. This method precipitated any soluble arsenic or fugitive antimony as environmentally stable sulfides.

Type of Impact/Media Affected: Tailing pond water containing soluble antimony and arsenic leached into the underlying aquifer, which recharged Prospect Creek. The U.S. Forest Service inspected the site in 1984 and discovered that the tailings piles were accessible to game animals, especially elk and deer, due to damage to the wildlife fence surrounding the effected area. The Forest Service determined elk, deer, and other animals, attracted by mineral salts in the tailings, were ingesting antimony and arsenic, thus exposing humans and other predators to contamination. The Forest Service inspection also revealed windblown tailings being deposited beyond the permitted tailings disposal area.

Regulatory Actions/Environmental Claims: The Montana Department of Health and Environmental Services issued an NOV and Corrective Action Order in December 1984 to address the contamination of the underlying aquifer and Prospect Creek. The Department ordered USAC to halt all activities and to submit a Study Plan including ground water and surface water monitoring and proposals for any necessary corrective action. USAC had met all the NOV requirements and, as noted above, the facility re-opened in 1987.

Bibliography: U.S. EPA. Draft. *Mining Waste Releases and Environmental Effects Summary for the State of Montana*. March 1994.

Nevada Moly Project:
Mercury Spilled Down Water Well at Copper Mine

Sectors: Copper and molybdenum

Facility: Nevada Moly Project, Cyprus Tonopah Mining, Tonopah, NV

Facility Overview: The site consisted of an open pit mine and a flotation mill with an on-site tailings impoundment.

Waste Stream(s): Tailings.

Waste Management Practices: Tailings were discharged from the mill to two 400-foot diameter thickeners, and the resulting slurry was piped to the on-site tailings impoundment. Tailings reclaim solution was recycled into the process water system.

Type of Impact/Media Affected: In May 1989, accidental drainage of a sodium hydrosulfide storage tank resulted in the release of process solution beyond the mill building's containment. The spill occurred near the copper concentrate storage area; consequently, much of the material was absorbed by the copper concentrate. Escaping solution followed the contours of the area downslope to the tailings impoundment sump.

In March 1990, a mercury spill occurred from a broken submersible pump seal. Mercury splashed on top of the flange, onto the surrounding top soil, and down the well. Approximately 5.783 kg of mercury was lost, and of that approximately 5.354 kg went down the well.

Regulatory Actions/Environmental Claims: On March 29, 1990, the Nevada Division of Environmental Protection (NVDEP) issued a Finding of Alleged Violation to Cyprus Tonopah Mining as a result of the spill of mercury into one of the on-site wells. NVDEP found that Cyprus allegedly violated NRS 445.221 by discharging a pollutant without a permit. Cyprus was ordered to cease pumping of the affected well, perform a video survey of the well, and submit a remediation plan. Cyprus' remediation plan was accepted. On December 11, 1991, NVDEP approved Cyprus' request to reconnect the remediated well to the site's water system.

References: U.S. EPA. Draft. *Mining Waste Releases and Environmental Effects Summary for the State of Nevada*. March 1994.

Taylor/Ward Project: Tailings Spill Pollutes Forest Service Lands

Sectors: Lead and Silver

Facility: Taylor/Ward Project, Alta Gold Company, East Ely, White Pine County, NV

Facility Overview: Prior to 1984 the site was used to produce silver, by milling, vat leaching, and refining. In 1990, the site was reopened. New operations included underground mining, milling, and conventional flotation designed to concentrate a lead-silver-copper-zinc ore.

Waste Stream(s): Tailings.

Waste Management Practices: A tailings line discharged into the tailings impoundment. No other information was available in the references reviewed for this document.

Type of Impact/Media Affected: In November 1990, a six-inch diameter tailings line disconnected at a diversion point, allowing the tailings stream to flow into natural drainage areas rather than into the tailings impoundment. Thirty thousand gallons of water carrying 40 to 45 tons of total suspended solids was released. The tailings flowed approximately 1.5 miles onto U.S. Forest Service land and then an additional 0.3 miles on Bureau of Land Management land. The tailings deposited down the drainage areas. Laboratory analysis concluded that the tails generated acid. The facility concluded, however, that it was unlikely that surface waters or ground water were contaminated and that the only environmental impact was of visual nature.

Regulatory Actions/Environmental Claims: The Nevada Division of Environmental Protection (NDEP) issued a finding of Alleged Violation and Order to Alta Gold Company in November 1990. NDEP found Alta in violation of Nevada Revised Statutes (NRS) 445.221 "Unlawful discharge of a pollutant without a permit" and item II. A. 2 of Alta's Water Pollution Control Permit No. NEV 90002, which states that Alta Gold "contain within the fluid management system all fluids including all meteoric waters which enter the system as a result of the 25 year 24-hour storm event." The order also required Alta to submit a scope of work to identify the extent of the contamination.

References: U.S. EPA. Draft. *Mining Waste Releases and Environmental Effects Summary for the State of Nevada*. May 1992.

Glen Ridge and Montclair/West Orange: Radioactive Waste Pollutes Residential Soils

Sectors: Uranium, thorium, and vanadium

Facility: Glen Ridge, Montclair/West Orange, U.S. Radium, Essex County, NJ

Facility Overview: These noncontiguous sites were contaminated with radioactive waste that may have originated from U.S. Radium, a former radium processing plant.

Waste Stream(s): Mill tailings.

Waste Management Practices: At U.S. Radium, mill tailings were discarded to unused areas of the main facility and liquids were poured down sewers. Some radium-contaminated soil from the U.S. Radium site was believed to have been moved and used as fill in nearby low-lying areas.

Type of Impact/Media Affected: The single greatest risk associated with these sites was long-term exposure to radon gas and its progeny (radionuclides). The transported soil had exhibited high levels of radium, uranium, and thorium, with contamination down to depths of more than 10 feet. Radium-226 in soil could have decayed to radon gas, which could have then migrated from the soil into houses to decay into particulate radionuclides, increasing the concentrations of radionuclides in indoor air. Both radon gas and gamma radiation were decay products of radium that had been detected in these study areas at unsafe levels. Elevated background levels of radionuclides were recorded from sediment samples in storm sewers indicating migration of contaminants via storm sewers.

Regulatory Actions/Environmental Claims: Preliminary investigations to assess the extent of contamination began in late 1983. Some houses were equipped with temporary radon ventilation systems and gamma radiation shielding to reduce indoor exposure to these radioactive contaminants. Houses were monitored on a quarterly basis for radon decay products. The New Jersey Department of Environmental Protection had problems obtaining a disposal facility for excavated materials and soil, forcing the Department to explore alternatives to excavation. Meanwhile, all buildings on the U.S. Radium site had been vacated and the entire area fenced off. Radiation shielding or ventilation systems monitored by EPA were used until each property was finally remediated.

References: U.S. EPA. Draft Final. *Mining Sites on the National Priorities List: NPL Site Summary Reports. Volume II*. June 21, 1991.

Chino Mine: Wastewater Overflow and Other Practices Pollute Creek

Sector: Copper

Facility: Chino Mine, Chino Mines Company, Hurley, NM

Facility Overview: Chino Mine consisted of an integrated open pit mine and copper reduction facility. The site contained a leach dump and a precipitation plant. A copper smelter was also located in the area.

Waste Stream(s): Acid plant blowdown, process wastewater, tailings, slag, and waste rock.

Waste Management Practices: Waste management units and operating practices included copper leach and waste rock dumps, tailings pond, discharges of acidic water from the precipitation plant to Whitewood Creek, smelter slag collection areas, discharges from surface impoundments holding mine water, and recycling of process wastewater. In May 1986, a power failure disabled the pumps that were used to recycle process wastewater through the leach circuit. As a result, process wastewater was diverted to an emergency containment basin (the Last Chance Reservoir), which eventually overflowed and 16,200 gallons of highly acidic process wastewater were discharged to Whitewood Creek. Other discharges of acidic waters to Whitewood Creek had occurred due to heavy rainfall.

Type of Impact/Media Affected: Over an extended period the Chino Mine site had released significant quantities of heavy metals and sulfuric acid to Whitewood Creek and to the shallow and deeper aquifers. Heavy metals including cadmium, chromium, cobalt, copper, nickel, zinc, arsenic, manganese, and lead had been detected well above background levels in soil, creekbed sediments, ground water, and surface water. Elevated levels of sulfate and total dissolved solids had also been detected in ground water.

Regulatory Actions/Environmental Claims: The New Mexico Environmental Improvement Division described the May 1986 spill as a "serious violation" of state regulations and suggested that the state would pursue a $10,000 fine. No information was available on any further regulatory actions.

References: U.S. EPA. Draft. *Mining Waste Releases and Environmental Effects Summary for the State of New Mexico*. March 1994.

Tyrone Mine: Tailings Dams Contaminate Ground Water

Sector: Copper

Facility: Tyrone Mine, Phelps Dodge Corporation, Grant County, NM

Facility Overview: Tyrone Mine was an open pit mine with a copper mill and leaching facility. Mining and milling for copper and other metals began in the late 1960's.

Waste Stream(s): Tailings.

Waste Management Practices: Tailing dams extended several miles down the valley in natural drainages. The dams were constructed along the natural drainages of the creek, and, in some cases, deposited on alluvium in tributaries.

Type of Impact/Media Affected: In 1989, increasing levels of Total Dissolved Solids (TDS) and sulfate were observed in two of the facility's ground water monitoring wells. Based on tailing dam deposition and seepage records, Phelps Dodge estimated that average flow to the ground water system from tailing dam seepage from 1978 to 1989 was 4,270 acre feet per year. Additional sources of inflow included seepage from tailings decant ponds, related decant systems, and leaching operations. Phelps studies concluded that oxidation of the tailings, accelerated oxidation of materials associated with historic mining activities in the area, as well as current mining and mineral processing operations, were potential sources of elevated TDS and sulfate concentrations near the top of the unconfined aquifer.

Regulatory Actions/Environmental Claims: The state made renewal of Phelps Dodge's Mangas Valley Discharge Plan contingent upon Phelps Dodge investigating the TDS/sulfate ground water problem.

References: U.S. EPA. Draft. *Mining Waste Releases and Environmental Effects Summary for the State of New Mexico*. March 1994.

Aurora Phosphate Plant: Wastewater Overflow Kills Fish

Sector: Phosphoric acid

Facility: Aurora Plant, Texasgulf Chemicals Company, Aurora, NC

Facility Overview: Since at least 1973, the plant had produced calcined and dried phosphate rock, sulfuric acid, phosphoric and superphosphoric acid, and other phosphate fertilizer ingredients.

Waste Stream(s): Gypsum waste and process wastewaters.

Waste Management Practices: Waste management units at the plant included clay slurry settling ponds, two unlined cooling water ponds, gypsum stacks, and clay blend piles, which contained a mixture of clay and gypsum.

The process of purifying the ore involved separating very fine clay particles from phosphate rock. The clays left the separation process as a water based slurry that was referred to as "slimes." They were hydraulically transferred to settling ponds where the clear water fraction was separated and discharged. The facility had five settling ponds that discharged to South, Bond, and Long Creeks via 12 permitted outlets.

Two cooling water ponds were used to recirculate process water through the phosphoric acid and fertilizer manufacturing areas, where it was used primarily in acid dilution, cooling, gypsum slurrying, and operation of emission control devices. Pond No. 1, with a surface area of 120 acres, began operation in November 1966. Pond No. 2, with a surface area of 9.7 acres, began operation in late 1973.

There were six gypsum stacks or piles located on the plant site. The stacks, which cover approximately 41 acres, were surrounded by a ditch that returned excess water from the stacks to Pond No. 1. There were also a number of gypsum-clay blend piles (designated R-1, R-2, R-4, and R-5) on the site that were used in land reclamation activities.

Type of Impact/Media Affected: Texasgulf investigations had focused on leakage from cooling ponds Nos. 1 and 2, which had resulted in ground water contamination of the first two water-bearing zones at the site. In 1988, Texasgulf commissioned a Preliminary Contaminant Assessment for Cooling Ponds 1 and 2 in fulfillment of requirements for the renewal of a zero discharge permit. As part of this study, Texasgulf installed 21 monitoring wells at the site in March and April of 1988. These monitoring wells included 10 wells at Cooling Pond No. 1, nine wells at Cooling Pond No. 2, and two background monitoring wells.

Initial ground water samples obtained from monitoring wells at each of the cooling ponds during April 1988 showed contamination in the surficial aquifer and the Croatan Aquifer, which underlaid the surficial aquifer at the site. Texasgulf subsequently began additional investigations to delineate the areal extent of contamination. The first zone appeared to be discharging to the facility's main effluent canal, while the direction of ground water flow in the next zone was toward Pamlico Sound. Texasgulf subsequently began additional investigations to delineate the extent of contamination. Initial results appeared to support the initial conclusion that contamination was confined to the upper two water-bearing zones and that the Yorktown formation had prevented downward migration of contamination.

Regulatory Actions/Environmental Claims: The North Carolina Department of Environmental Management had recorded a number of incidents dating back to 1980 at the plant that may have harmed the environment. These incidents included violations of Texasgulf's effluent permit and spills from the facility. For example, violations of the effluent permit for daily maximum phosphorus and fluoride were recorded in 1980 on March 12, March 13, December 9, and December 11. Daily maximum permit limits were 9 mg/L for phosphorus and 10 mg/L for fluoride. Recorded concentrations for the four days ranged from 11 to 34 mg/L for phosphorus. Fluoride concentrations were 12 mg/L on March 12 and March 13. These violations occurred when contaminated wastewater from the toe ditch of the gypsum pile overflowed into the company's fresh water system. A spill of 40 million gallons of gypsum stack decanted water into a nearby fresh water canal occurred on January 4, 1987, when a retaining dike around one of the gypsum stacks failed. A 24-hour analysis of the canal water showed a pH drop to a low of 4.2, with a two-hour period when pH was below 6.0. At least 18 dead fish were counted along the canal. The company was fined $1,000 for the incident by the State of North Carolina.

References:

U.S. EPA. *Report to Congress on Special Wastes from Mineral Processing Facilities. Volume II: Methods and Analyses*. July 1990.

U.S. EPA. *Report to Congress on Special Wastes from Mineral Processing. Technical Background Document: Damage Case Investigation*. July 1990.

Great Plains Coal Gasification Plant: Gasifier Ash Contaminates Ground Water

Sector: Coal gasification

Facility: Great Plains Coal Gasification, Plant, Dakota Gasification Company, Beulah, Mercer County, ND

Facility Overview: The coal gasification facility produced synthetic natural gas that was sent to a refinery for processing as a natural gas.

Waste Stream(s): Ash from Lurgi gasifiers.

Waste Management Practices: Ash from the gasifier was quenched with blowdown from the wet scrubber system on the facility's incinerator and sluiced into one of four ash sumps where the ash was settled from the slurry. The liquid recovered during the ash dewatering was recycled back to the ash quench and sluicing area or used as makeup water to the liquid waste incinerator. The dewatered ash was trucked to an on-site landfill.

SU-101 was the active portion of the landfill that received gasifier ash. Large pits within the SU-101 area were utilized for the disposal of the gasifier ash and other waste streams. According to the North Dakota State Department of Health and Consolidated Laboratories (NDSDHCL), at least 90 percent of all waste disposed in SU-101 consisted of gasifier ash. Excess liquids from the gasifier ash disposed in area SU-101 flowed with any additional run-off to the adjacent sumps and may have been later pumped to the evaporation pond. Analytical data from August 1989 show that the pH of water in the sump ranged from 12.7 to 13.7, while the arsenic concentration ranged from 13.8 mg/L to 22.0 mg/L, and the selenium concentration ranged from 1.1 mg/L to 2.2 mg/L.

Type of Impact/Media Affected: The plant site was located on a broad valley that was underlain by the Antelope Valley or Beulah Trench aquifer. The Beulah Trench interconnected with the aquifer associated with the Knife River Valley, which served as a water supply source for the communities of Beulah and Hazen, located approximately nine miles south and 14 miles southeast of the plant site, respectively. The mine used as the coal supply for the plant was located immediately east of the facility.

In December 1985, NDSDHCL expressed concerns to ANG (the former owner of the facility) regarding the levels of water in the run-off pond within the ash storage area, because of high pH and high arsenic content in the run-off water. The Department stated that the disposal of gas ash containing excess liquids must be discontinued immediately.

According to quarterly monitoring reports submitted by DGC to NDSDHCL from April 1988 to June 1989, monitoring wells around a portion of the landfill area indicated significant differences in concentrations between downgradient and upgradient wells. From five to six total samples taken from upgradient wells 15, 16, and 17, Electrical Conductivity (EC) averaged 4,790 µmhos/cm; sulfates (SO_4) averaged 1,248 mg/L; and total dissolved solids (TDS) averaged 3,638 mg/L. From eight total samples taken from downgradient wells, 14, 18 and 24, EC averaged 11,870 µmhos/cm; SO_4 averaged 7,056 mg/L; and TDS averaged 11,569 mg/L.

Monitoring well analytical data in a DGC report dated February 22, 1989, indicated that three additional wells near the ash disposal area had exhibited "increased concentrations" of some constituents. Analysis of samples from one of these wells revealed increased mean specific conductance (15,000 µmhos/cm), as well as increased mean concentrations of sodium (3,000 mg/L), sulfates (11,000 mg/L), and TDS (17,000 mg/L). Background, or upgradient data, were not provided. The other two wells contained similar concentrations, and over a period of one year or less, historical data documented increases in these constituent levels (see exhibit below).

Regulatory Actions/Environmental Claims: In July 1987, NDSDHCL Division of Waste Management and Special Studies prepared a memorandum that summarized letters written and inspections conducted relating to ANG's gasifier ash dewatering system and disposal area. This memorandum requested the issuance of an NOV to ANG for improper waste handling procedures relating specifically to the dewatering of gasifier ash, the unauthorized placement of associated liquids and sludges having potentially hazardous characteristics in the gasifier ash disposal area, and the spillage of ash, liquids and sludges during their transport from the dewatering area to the ash disposal area. The memorandum discussed ANG's violations of the state's Solid Waste Management rules, including the unauthorized placement of liquid and semi-liquid wastes in a landfill not permitted for such wastes, the unauthorized improper construction and operation of the disposal site, the inadequate protection of surface water in violation of permit conditions, and the spillage of liquids, sludges, and ash during transport. As stated in the memorandum: "ANG's [practices have] . . . increased the potential for ground water degradation and [have] probably resulted in some surface water degradation."

According to the NDSDHCL, Dakota Gasification discontinued the use of unlined ponds for the disposal and storage of liquid-bearing wastes in 1988. Ponds since mid-1988 had a liner.

Department inspections of the DGC facility in October and November 1989 cited DGC for constructing an industrial waste landfill that did not meet requirements of the renewed permit, and for noncompliance with the North Dakota Solid Waste Management Rules. The reference did not contain any discussion of any fines or NOV's for the facility's waste management practices.

Increases in Concentrations of Selected Constituents in Two Gasifier Ash Disposal Area Monitoring Wells (1987 - 1988)

Well	Net Increase in Parameter Value Between Sampling Periods				
	Cl (mg/L)	SO_4 (mg/L)	Na (mg/L)	Spec. Cond. (µmhos/cm)	TDS (mg/L)
W04018	3,910	840	1,125	11,290	---
W04020	2,114	525	877	5,200	3,759

References: U.S. EPA. *Report to Congress on Special Wastes from Mineral Processing Facilities. Volume II: Methods and Analyses*. July 1990.

U.S. EPA. *Report to Congress on Special Wastes from Mineral Processing. Technical Background Document: Damage Case Investigation*. July 1990.

Confidential Site:*
Drinking Water Contaminated at Phosphate Mine

Sector: Phosphate

Facility: Confidential

Facility Overview: The site was involved in mineral processing. The facility extracted and stored phosphorous before shipping.

Waste Stream(s): Process wastewaters generated from production of phosphate, which were exempt under Section 3001b(3)(A)(ii) of RCRA.

Waste Management Practices: About 50 percent of the waste slag was sold for use as highway construction material, and the remainder was deposited on two on-site waste piles. Other waste was crushed, stored on bare ground, and later sold for its vanadium, iron, and chromium content. The remaining wastes were deposited in on-site ponds. The facility also had a landfill. On-site run-off was discharged to a nearby river after being mixed with boiler blowdown water in the unlined lagoon.

The site contained two gypsum stacks, an unlined liquid gypsum pond, an unlined cooling pond, and three lined wastewater treatment ponds. The ponds were used to collect and treat all unrecycled wastewater. Another pond received boiler blowdown cooling water and some surface run-off, which was then piped to the wastewater treatment plant.

Type of Impact/Media Affected: The metals detected in the ground water corresponded to those elements (arsenic, cadmium, and zinc) detected at high concentrations in the unlined waste ponds. Contaminants had been detected in a nearby spring, used for drinking water at a local cafe, which was consequently condemned, and the river, used for recreation and irrigation.

Regulatory Actions/Environmental Claims: Several site investigations had quantified the effect of mineral processing on the surrounding environment. During the early 1970s, a ground water monitoring study conducted by the state detected levels of arsenic, cadmium, and lead above the Federal Primary Drinking Water Standards. A subsequent Environmental Impact Statement (EIS) prepared by the United States Geological Survey also documented contamination. In addition, an EPA inspection report stated that 50 drums of PCB contaminated material was landfilled on-site. A more recent site inspection noted a cone of depression in the two main aquifer systems from high rates of pumpage. A Draft Health Assessment had been completed. The site is on the NPL.

References: U.S. EPA. Draft. *Final Mining Waste NPL Site Summary Reports*. June 21, 1994.

* This site is classified as confidential because of impending enforcement action.

ASARCO Zinc Mine:
Acutely Toxic Releases to Surface Water

Sector: Zinc

Facility: ASARCO, Columbus, OH

Facility Overview: American Zinc Oxide owned the smelter from 1918 to 1970, when ASARCO purchased the property and operated it until ceasing production in 1986. The facility produced zinc oxide.

Waste Stream(s): Zinc slag.

Waste Management Practices: The facility produced zinc oxide from sphalerite ore by oxidation, reduction, and back oxidation. Until recently, it appeared that all zinc slag was disposed and/or stored on-site when ASARCO began selling its slag for further zinc recovery to Horsehead Resources. As of 1986, about 38,000 tons of zinc slag had been stored on the site in two primary slag piles: the northern pile, covering about 13 acres; and the southern pile, covering about 37 acres.

Run-off from the facility drained to an open ditch near Joyce and 12th Avenues, referred to as the Joyce Ave. outfall. The receiving ditch, referred to as the American Ditch, flowed about one mile through an industrial and residential area. Until June 1989, when the American ditch was diverted to discharge directly to Alum Creek, flow from the American ditch entered the combined sewer of the City of Columbus. Alum Creek was classified as a primary contact, warm fishery, public, industrial, and agricultural water supply.

Type of Impact/Media Affected: In 1972, the City of Columbus found that its wastewater treatment facility was receiving excessive zinc and cadmium loadings from water originating at the ASARCO smelter site. Investigations eventually led to the conclusion that run-off and leachate from the on-site zinc slag were responsible for the excessive loading. Water samples taken by the City of Columbus from the American Ditch, which bisects the facility, showed cadmium and zinc concentrations above limits established by the City. Dissolved cadmium measured 0.56 mg/L while dissolved zinc measures 92.0 mg/L; the recorded pH was 2.6.

Regulatory Actions/Environmental Claims: A 1981 analysis performed by the City of Columbus on ASARCO's discharge to the American Ditch showed that the discharge exceeded by several times the 3.0 mg/L City limit for zinc and that cadmium concentrations were also above the 0.5 mg/L City limit. ASARCO was cited by the City for violations of discharge limits for cadmium and zinc into the sewer system.

Slag area run-off sampling data for September and October 1986 revealed zinc concentrations of 26 mg/L and 46 mg/L, respectively. At that time, ASARCO agreed to begin removing the zinc slag from the facility. In August 1987, the Ohio EPA described the situation at this facility by stating that, "[d]ue to past practices over many years of dumping waste slag or clinker all over the site, there was still a problem with contaminated run-off. There were documented problems with high concentrations of zinc and cadmium in the run-off." In November 1987, ASARCO notified the City of its shipment off-site of 35,000 tons of zinc slag.

Subsequent testing had shown that the release of contaminants into surface waters continued. An Ohio EPA inter-office communication from June 1988 included a report which stated that "overall analysis of cadmium and zinc concentrations from the Joyce Avenue outfall [ASARCO's discharge to the American Ditch] suggests acutely toxic conditions exist on a frequent basis." For zinc, 20 percent of water samples (5 percent for cadmium) taken from the ASARCO treatment center outfall were reported to have exceeded the Final Acute Value limits (188 µg/L for cadmium and 1,298 µg/L for zinc) established for American Ditch to protect against rapidly lethal conditions within a water body.

References: U.S. EPA. *Report to Congress on Special Wastes from Mineral Processing Facilities. Volume II: Methods and Analyses*. July 1990.

Martin Marietta Reduction Facility: Aluminum Production Facility Placed on NPL

Sector: Aluminum

Facility: Martin Marietta Reduction Facility (MMRF), The Dalles, Wasco County, OR

Facility Overview: The facility began operating in 1958. Aluminum production from alumina took place in a reduction cell, outlined with alumina insulation and carbon potlining. An electrical current was passed through a solution of aluminum oxide dissolved in a bath of molten crystolite. The aluminum and oxygen separated with aluminum forming on the cathodic surface.

Waste Stream(s): Asbestos, metallic wastes, spent cathode-waste materials containing cyanide, polynuclear aromatic hydrocarbons (PAHs), and arsenic.

Waste Management Practices: Wastes were generated from spent cathodes and anodes utilized in the alumina reduction process. Waste management from 1958 to 1972 involved washing and temporarily storing spent cathodes, which were shipped off-site via railroad. From 1972 until 1984, wastes were disposed of on-site.

A landfill occupied approximately 15 acres immediately north of the alumina reduction building. Wastes were randomly deposited on the ground surface. A leachate-collection system controlled the amount of leachate generated by the landfill.

In 1958, a scrubber system began generating air emission-control sludge containing high levels of fluoride, sulfate, and PAHs. The scrubber sludge was either discharged to a pond to settle out particulates or recycled into production.

Surface water ponds at the site included four scrubber sludge ponds, the Recycle Pond, and the Lined Pond. The Recycle Pond served as a collection point for run-off from the Landfill, the Old Cathode-waste Management Area, and areas immediately south and west of the alumina plant. The Recycle Pond discharged into the Columbia River under a NPDES permit. The Recycle Pond was used to control surface water run-off, but was not an active part of the plant's wastewater recycling system. Similarly, the Lined Ponds were no longer in use as part of the plant's production operation due to remediation.

Type of Impact/Media Affected: Ground water samples taken in various areas of the site had identified total and free cyanide, fluoride, sodium, and sulfate. Potentially unacceptable carcinogenic risks from exposure or direct contact were expected in certain areas of the site. PAHs had been detected in landfill soils, surface drainage ditch sediments, soils in the Potliner Handling Area, sediments in the Discharge Channel, and pond sediments in the Scrubber Sludge Ponds.

Regulatory Actions/Environmental Claims: MMRF was placed on the NPL in 1987. The remedial alternative selected by EPA included institutional controls such as deed restriction and fencing.

References: U.S. EPA. Draft Final. *Mining Sites on the National Priorities List: NPL Site Summary Reports. Volume III*. June 21, 1991.

Teledyne Wah Chang Albany: Ground and Surface Water Contaminated by Metals Manufacturing Wastes

Sectors: Hafnium, niobium, tantalum, vanadium, and zirconium

Facility: Teledyne Wah Chang Albany (TWCA), Millersburg, Albany County, OR

Facility Overview: Since 1956, the facility has been a primary manufacturer of zirconium metal. Zircon sand underwent a chlorination process producing zirconium tetrachloride and silicon tetrachloride. Methyl isobutyl ketone (MIBK) was added to remove the hafnium portion of the zirconium. The resulting oxides underwent a second chlorination step, a reduction process using elemental magnesium, and consolidation of zirconium sponge into ingots.

Waste Stream(s): Sand chlorinator residues, MIBK still bottoms, magnesium chloride wastes, smokehouse residue, and slag wastes containing niobium and iron metals.

Waste Management Practices: TWCA operated a wastewater treatment system consisting of a continuous chemical precipitation and sedimentation. The system generated treated wastewater and sludges to handle industrial wastewaters resulting from metals manufacturing. The treated wastewater was discharged to Truax Creek, while sludges were placed in storage ponds for additional settling and dewatering. Until 1979, solids produced from the treatment processes were stored in the settling ponds.

TWCA obtained a solid waste permit to use the sludge as a soil amendment on the TWCA Farm Site in 1976. In 1979, the Farm Ponds operated as solids storage ponds for sludge from the wastewater treatment processes. Modification of the production process reduced the concentrations of radioactive materials in the sludges, directing them to a separate solid waste stream that was shipped to Hanford, WA for disposal.

Solid wastes were initially delivered to the Dumpmaster Area, where they were inspected and separated into nonhazardous and hazardous components. The former were disposed of at a public landfill, whereas the hazardous wastes were stored on-site until they can be transported off-site to a hazardous waste storage, treatment, or disposal facility.

TWCA also operated three on-site areas for the disposal of solid waste. Chlorinator residue was stored in a pile until 1978 when the waste had been transferred to Hanford, WA. Solid residues from the nonferrous metals manufacturing process were placed in the magnesium resource recovery pile until May 1983. Later that year, TWCA began operations to recover and beneficially use the contents of the pile.

Type of Impact/Media Affected: Ground water samples collected in the area of the farm ponds found concentrations of heavy metals (including cadmium, chromium, and lead) exceeding the Federal Primary Drinking Water Standards. The maximum concentrations for chloride, iron manganese, sulfate, and TDS exceeded federal Secondary Drinking Water Standards. Sample data indicated low levels of volatile and semivolatile organic compounds in the surface waters on and around the site. Specifically, Chloroform and 1,2-dichloroethane exceeded the surface water Ambient Water Quality Criteria (AWQC) for water and fish ingestion.

A general assessment of risks for the entire TWCA site included the threat to workers by radon gas, the potential that flooding could have caused widespread contamination of radioactive wastes, the contamination of the land by the application of radioactive materials, and the potential for ground water and surface water contamination.

Regulatory Actions/Environmental Claims: TWCA had water and air emission permits. The facility had been cited for numerous violations of its NPDES permit. TWCA was assessed fines for other water quality permit violations in 1979, 1980, and 1989. The company was fined for illegal open burning in 1983. In October of 1983, TWCA was listed on the NPL. TWCA was cited for several violations of Oregon's hazardous waste management rules in 1986. In May of 1987, TWCA signed a Consent Order to conduct a Remedial Investigation/Feasibility Study.

References: U.S. EPA. Draft Final. *Mining Sites on the National Priorities List: NPL Site Summary Reports. Volume V*. June 21, 1991.

Aliquippa Works:
High pH in Ground Water Leachate

Sectors: Iron/steel

Facility: Aliquippa Works, Jones and Laughlin Steel Corporation (J&L, or LTV Steel), Aliquippa, Beaver County, PA

Facility Overview: The Aliquippa Works was closed around 1985. When operational, the Aliquippa facility contained both blast furnace and basic oxygen furnace operations.

Waste Stream(s): Blast furnace and basic oxygen furnace slag.

Waste Management Practices: The Black's Run area had served as a storage and disposal site for over 40 years. In 1980, J&L commenced operation of a RCRA Subtitle C landfill within the Black's Run site for disposal of certain designated hazardous wastes generated by J&L's iron- and steel-making processes. The primary hazardous waste disposed at Black's Run was air pollution-control dust from electric arc steelmaking furnaces at J&L's Cleveland and Pittsburgh Works.

The disposal cell was lined with multiple layers: a two foot layer of basic oxygen furnace slag, covered with one and one half feet of low permeability flyash, and topped with a three foot layer of slag. The landfill was constructed on a slope, directing leachate downward to be collected and treated at the 'toe' of the slope.

Type of Impact/Media Affected: Documented environmental impacts had occurred in two general areas of the site. The first area was the Black's Run Landfill, which was lined with basic oxygen furnace slag. Leachate from this landfill had entered Black's Run Creek. The second area was the Aliquippa Works facility itself. At least a portion of the facility was underlain by blast furnace slag, which had a thickness of 52 feet in some places. This blast furnace slag was contaminating shallow ground water that seeped into surface water.

Basic Oxygen Furnace Slag

By 1982, Pennsylvania Department of Environmental Regulation (PADER) investigators found indications that leachate from the landfill was discharging into the East Fork of Black's Run Creek, and that a white precipitate had been deposited on the stream bottom downstream of the landfill. The inspector reported that the leachate was apparently not from the electric furnace dust and sludge, but rather from the slag and ash liner. This white deposit, attributed to the slag liner, was noted in 1987 and 1988 as well.

Samples taken in March 1987 showed Black's Run Creek upstream of the landfill at a pH of 8.43, and total dissolved solids (TDS) at 597 mg/L. Downstream of the landfill, the pH of Black's Run was elevated to 12.30 and TDS to 1,925 mg/L. Monitoring well sampling on this same date showed a significant increase in pH from the upgradient shallow well at a mean of 7.71 to the downgradient shallow well at a mean of 9.29, exceeding the National Secondary Drinking Water Regulations maximum pH level of 8.5. Analytical data for parameters other than pH and TDS were not contained in the available documents.

In a June 1988 inspection report, the PADER inspector noted that visible impacts to the Black's Run Creek occurred much farther downstream than when they had been first noted several years previously. The inspector found the creek bottom covered with precipitate for approximately 500 yards downstream. The PADER inspector also stated that little aquatic life was evident in the creek from the point where it passed the landfill until well below all the seeps, close to where the stream goes under Route 51. In June 1988 another inspector found erosion problems on the soil cap of the closed landfill, and an unsatisfactory revegetation status.

Blast Furnace Slag

As mentioned previously, the Aliquippa Works facility itself was constructed on blast furnace slag fill, which was at least 52 feet thick in some places.

In a cover letter for monitoring data submitted by LTV to PADER, LTV discussed elevated pH and TDS values in seep samples, stating that such values "are not unexpected from areas where the slag was placed for fill." Analytical data from these seeps from 1977 through 1985 showed pH values ranging from 12.1 to 13.1, while TDS values ranged from 1,370 mg/L to 3,508 mg/L.

In a letter to PADER in December 1987, LTV discussed its NPDES violations. LTV reported two outfalls discharging water with pH values of 10.9 and 10.4, exceeding the maximum permitted pH of 9.0. LTV explained that "the fill in the area of the two outfalls is all blast furnace slag. This would cause high pH in rainwater entering the now idled sewers."

LTV's November 1988 NPDES monitoring results submitted to PADER indicated an exceedance of the maximum permitted pH level of 9.0 in an outfall with pH 9.4. LTV again explained that the Aliquippa Works was built on slag fill. LTV noted that since no operating facility uses the sewer of concern, ground water from the slag filled areas was probably infiltrating the sewers and causing the high pH.

Regulatory Actions/Environmental Claims: The landfill was closed in September 1987 because its slag liner did not meet the revised standards for an operating permit. Closure activities involved regrading, capping with a clay/soil layer, and securing the area with a fence. Monitoring wells were installed around the landfill at depths to monitor both the shallow aquifer and a deeper aquifer.

References: U.S. EPA. *Report to Congress on Special Wastes from Mineral Processing Facilities. Volume II: Methods and Analyses*. July 1990.

U.S. EPA. *Report to Congress on Special Wastes from Mineral Processing. Technical Background Document: Damage Case Investigation*. July 1990.

Foote Mineral Company: Lithium Detected in Ground Water

Sector: Lithium

Facility: Foote Mineral Company, East Whiteland Township, PA

Facility Overview: Since 1941, the site has produced lithium chemicals; other processed lithium metal produced lithium bromite, chloride, and fluoride; and manufactured pre-fused fluxes.

Waste Stream(s): Process wastes.

Waste Management Practices: The site contained three unlined settling ponds, a burn pit, two quarries, and an area where containers of lithium arsenite were buried. A quarry was filled with 120 million pounds of process waste material, including 60 tons of calcium aluminum silicate. Cyprus Mineral Co. excavated and treated 15,000 sq. yds. of soil using a bioremedial technique in 1992.

Type of Impact/Media Affected: The contaminated media included soil, surface water, and ground water. Ground water sampling in 1988 detected high lithium concentrations, as well as arsenic, hexavalent chromium, and antimony contamination. These contaminants were also detected in surface water samples in 1984.

Regulatory Actions/Environmental Claims: No regulatory actions were discussed in the reference reviewed.

References: U.S. EPA. Draft. *Mining Sites on the NPL.* August 1995.

Palmerton Zinc:
Enormous Waste Pile Pollutes Soil and Creek

Sectors: Lead and zinc

Facility: Palmerton Zinc, Borough of Palmerton, Carbon County, PA

Facility Overview: Two primary zinc smelters produced zinc and other metals for machinery, pharmaceuticals, pigments, and other products from 1898 to 1987. The first smelter produced zinc oxide and the second smelter concentrated zinc sulfide ores.

Waste Stream(s): Process residues (cinders) and other wastes.

Waste Management Practices: From 1898 to 1970, process residues, other plant wastes, and municipal wastes were deposited at a cinder bank waste pile located behind the East Plant.

Type of Impact/Media Affected: The Palmerton Zinc Superfund site had four problem areas: (1) The Cinder Bank; (2) The defoliated portion of Blue Mountain near the smelter slag piles; (3) Heavy metal deposition throughout the valley; and (4) The overall ground water and surface water contamination. The first two operable units had been investigated.

Surface-soil samples collected in the Blue Mountain Operable Unit recorded levels of cadmium, lead, and zinc at 2,600, 2,000, and 400 times the regional background levels, respectively. Vegetation damage first appeared in 1951 as isolated patches on the steep, north-facing slope of Blue Mountain. By 1985, approximately 2,000 acres had sustained vegetation damage (i.e., areas of exposed rock and soil leaving barren, eroded land visible). Water flowing off the defoliated portions of the Blue Mountain had eroded the surface and become contaminated with metals in the soil. The run-off and erosion had carried the metal-ladened soil into Aquashicola Creek, which was stocked with trout annually.

Process residues and other plant wastes were deposited on the Cinder Bank until it had become 2.5 miles long, between 500 and 1,000 feet wide, and up to 100 feet above the mineral soil layer. In December 1986, it was estimated to contain 28.3 million tons of leachable metals including lead, zinc, and cadmium. Contaminated leachate percolated down to the ground water and seeped out of the Cinder Bank.

Regulatory Actions/Environmental Claims: Palmerton Zinc was added to the NPL in September 1983. In compliance with the EPA's Administrative Order by Consent, dated September 24, 1985, sampling of all affected media was conducted on behalf of the New Jersey Zinc Company, by R.E. Wright Associates, Inc. In a February 6, 1987, memorandum, the Agency for Toxic Substances and Disease Registry found that a potential human health risk existed through the consumption of fish from Aquashicola Creek.

References: U.S. EPA. Draft Final. *Mining Sites on the National Priorities List: NPL Site Summary Reports. Volume IV*. June 21, 1991.

Brewer Gold Mine: Cyanide Release from Gold Mine Affects Biotic Communities

Sector: Gold

Facility: Brewer Gold Mine, Brewer Gold Mine Company, a subsidiary of Westmont Mining Inc., Jefferson, Chesterfield County, SC

Facility Overview: Gold mining operations included heap leaching, carbon adsorption, and electrowinning. Ore was hauled to on-site crushers, agglomerated, and conveyed to a heap leach pad, where a cyanide solution was used to recover gold.

Waste Stream(s): Spent leaching solution.

Waste Management Practices: Seven heap leach pads were rinsed to reduce cyanide levels and pH. Leachate collected from the leach heaps was run through carbon adsorption columns. Lined ponds held barren, pregnant, and rinse solutions.

Type of Impact/Media Affected: Since the opening of the facility in July 1987, the spills and other incidents included liner ruptures, leach pad collapses, barren solution hose breakages, solution line ruptures, pond discharges, ore slides, pipe leakages, and dam failures. In October 1990, a tropical storm caused a 10 to 12 million gallon, 100 mg/L cyanide solution release. A study conducted in March 1991 pursuant to an EPA order indicated that the macroinvertebrate and fish communities in Little Fork Creek and Fork Creek downstream of the October cyanide release continued to show signs of the release's impact. While Lynches River showed improvement, sampling locations on Little Fork Creek showed little to moderate improvement in terms of biotic organisms.

Regulatory Actions/Environmental Claims: The South Carolina Department of Health and Environmental Control (DHEC) and the Land Resources Commission (LRC) were notified of each incident and responded to each with Consent Orders and fines. In October 1990, a precautionary statement was issued by the state that asked people not to drink, bathe, swim, or water livestock in affected waters due to the dam failure. Subsequently, EPA Region 6 issued an Administrative Order and the state issued Consent Order 91-30-W to the Brewer Gold Company. EPA's order required a remediation plan for sampling in the discharge area and stream sediment in Little Fork Creek, Fork Creek, and Lynches River to determine if remediation of soil or sediments was necessary. A State Notice of Enforcement Conference listed specific violations of NPDES limits and of requirements to obtain permits, all of which Brewer claimed were without basis. In the Consent Order, Brewer agreed to submit status reports on waste management practices and pay a civil penalty or $50,000. DHEC and LRC issued (or modified) permits for the redesign and reconstruction of the overflow pond and dam. In addition, LRC required Brewer to retain a qualified independent professional engineer to determine the cause of the dam failure and to review the design for the replacement dam.

References: U.S. EPA. Draft. *Mining Waste Releases and Environmental Effects Summary for the State of South Carolina*. March 1994.

Gilt Edge Project:
Liner Leaks Contaminate Ground Water

Sector: Gold

Facility: Gilt Edge Project, Brohm Mining Company, Deadwood, SD

Facility Overview: The facility included an open pit mine, an on-off leach pad and associated solution ponds, a gold recovery plant, and spent-ore and waste rock piles. Leaching operations began in October 1988.

Waste Stream(s): Spent barren solution.

Waste Management Practices: The heap leach was divided into seven cells. The original lining system at the base of the leach pad included a primary and a secondary liner with a leakage detection, collection, and removal system drainage layer. A seven million gallon surge pond was used to store both pregnant and barren solution. Primary liners under several leach cells leaked during initial leaching operations. To eliminate the risk of future leakage, Brohm began hauling process solution from the surge pond to Homestake Mine's tailings facility. A reverse osmosis unit was installed to treat excess solution to levels below South Dakota ground water quality standards. Cyanide releases caused Brohm to construct two unlined containment ponds to collect released solution. Brohm then neutralized the cyanide with hydrogen peroxide. A bioremediation plan was approved by the state for contaminated soils and ground water. Brohm also began extensive monitoring of nearby ground and surface water.

Type of Impact/Media Affected: Several spills had released cyanide solution, ponded solution, and spent ore to the environment. Results of regularly scheduled surface water monitoring showed detectable levels of cyanide in Strawberry Creek immediately downstream of the processing facilities and Bear Butte Creek. Cyanide was also detected in local ground water. In addition, six dead birds were found in the surge pond in 1991.

Regulatory Actions/Environmental Claims: The state conducted numerous inspections between 1988 and 1990. Two Notices of Violation (NOVs) were issued to Brohm. The first NOV in 1988 required the facility to suspend active leaching and repair the primary liner. After extended discussions, the state and Brohm reached a settlement agreement where the facility agreed to pay a fine of $100,000 and the state withdrew the 1988 NOV because no damage to human health and the environment had occurred. The second NOV in 1991 was issued after ground water contamination was detected. It required the facility to stop releasing process solutions, complete installation of the VLDPE liner, and characterize the extent of ground water contamination. Because of the levels of cyanide discharged and detected in ground water and surface water, the state maintained frequent contact with the facility and conducted numerous investigations that included sampling and analysis.

References: U.S. EPA. Draft. *Mining Waste Releases and Environmental Effects Summary for the State of South Dakota.* March 1994.

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